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# FINAL WORK PLAN

FOR WATERSHED PROTECTION, FLOOD PREVENTION  
AND  
RECREATIONAL DEVELOPMENT

## UPPER LITTLE BLACK WATERSHED

Butler, Carter and Ripley Counties  
Missouri



U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE



OUR SOIL ★ OUR STRENGTH

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# ADDENDUM

## UPPER LITTLE BLACK WATERSHED, MISSOURI

This addendum shows project cost based on 1973 price base for construction costs amortized for 100 years at 5-7/8 percent interest.

Benefits for this addendum are based on current normalized prices for agricultural commodities and original values for recreation.

Annual project benefits, costs, and benefit-cost ratio are as follows:

Total benefits	\$1,145,556
Total costs	753,037
Benefit-cost ratio	1.5:1.0

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ADDENDUM

UPPER LITTLE BLACK WATERSHED WORK PLAN

BUTLER, CARTER, AND RIPLEY COUNTIES, MISSOURI

AUGUST 1974

This addendum was prepared to meet interim requirements for implementing principles and standards for planning water and related land resources of the Water Resources Council.

It includes the following three parts:

- I. Benefit Cost Relationship - Part I shows the effects of 5-7/8 percent interest on the selected plan for the Upper Little Black Watershed. Costs are those for works of improvements located in the Upper Little Black Watershed area and benefits have been prorated between both the Upper and Lower Little Black Watershed plans.
- II. Abbreviated Environmental Quality Plan - The abbreviated EQ plan covers both the Upper and Lower Little Black Watershed areas.
- III. Display of Accounts - Part III is a display of the national economic development, environmental quality, regional development, and social well-being accounts of the selected plan for the Upper Little Black Watershed.

## PART I

### BENEFIT COST RELATIONSHIP

The following data shows the benefit cost relationship using 1973 prices for project costs and 5-7/8 percent interest rates for amortization. Benefits are on a current normalized price base for agricultural commodities. Recreation benefits are represented by values set forth in USDA procedures for planning water and related land resources dated March 1974.

Annual project benefits are	\$1,145,556.
Annual project costs are	753,037.
The benefit cost ratio is	1.5:1.0.

UPPER AND LOWER LITTLE BLACK WATERSHEDS  
MISSOURI

PART II

Abbreviated Environmental Quality Plan

The environmental quality of this watershed has been degraded, and existing values are in jeopardy. This abbreviated environmental quality plan has been formulated to protect and enhance natural environmental values.

Environmental Problems

Extensive forest stands of the same size, and even ages limit natural beauty and wildlife potential. Clearing of bottom land forest has removed most of the native vegetation. The predominance of forest land in the upland and cropland in the bottom lands, result in a lack of diversity in these areas. Both upland forest and delta croplands need greater diversity of natural and man-induced systems. Unmanaged grazing of forest land and pastureland reduces agricultural production and the value of these areas for wildlife habitat. The presence of livestock detracts from the scenic and esthetic value of the stream system. Uncontrolled forest fires destroy or degrade forest resources, farmsteads, and wildlife habitat.

Flat water resources, such as lakes and ponds, are limited, and are principally located on private land where access is very limited. Many scenic land and water areas are present, but few are accessible.

Junk cars, trash, countryside dumps, and roadside litter degrade the natural beauty of the area, and serve as breeding places for disease vectors.

Poor management of uplands result in accelerated erosion from all land uses. Most upland soils are not suited for use as cropland. Where cropping exists, most fields need management to reduce soil loss. Some cropland is present on sites where soils or slope conditions make the site poorly suited for cultivation. Some sandy delta soils need to be vegetated to reduce wind and runoff erosion. Soil losses, by land uses, are listed as follows:

<u>Land Use</u>	<u>Sheet Erosion - Tons/Acre/Year</u>
Cropland	7.2
Idle Land	4.0
Pastureland	3.0
Forest Land	4.2
Other	4.0



Roadside and other erosion is estimated to yield the equivalent of 1.4 tons of sediment per watershed acre per year. Streambank erosion is estimated to yield the equivalent of 1 ton of sediment per watershed acre per year. Areas denuded for construction activities need vegetative planting and seeding. Land treatment needs to prevent accelerated erosion are estimated as follows: cropland, 45,700 acres; pastureland, 18,000 acres; forest land, 104,400 acres; and other land, 6,200 acres. There are 86 miles of eroding roadbanks (approximately 200 acres), 20 miles of eroding streambank (approximately 80 miles), and 6,800 acres of bottom land subject to scour erosion. Old scour channels get deeper and wider and new scour channels are created with each major flood. Excessive erosion occurs where local field and road drainage enter ditches in the delta. Floods deposit sediment, scour flood plain lands, scatter debris, and endanger humans and animals in flooded areas. Continued overland flows are expected to change the course of the Little Black River from the present course to one along one of the drainage ditches.

Water quality is degraded by nutrients and pesticides due to uncontrolled runoff and flooding. The quantity of flows in tributaries vary from no flow to floods. Neither extreme is good and periods of moderate flow are short. Improper waste disposal will eventually degrade water quality due to soil and bedrock conditions. Water quality of streams and drainage ditches is also decreased by turbidity during high flows, and by low flow or stagnancy during droughts.

Three species of animals considered rare or endangered are native to the area. The present status of these animals is largely due to loss of habitat and development and use of the area by man.

Old military roads and indian trails cross the area. These are not marked or preserved in any way. An artesian well is present but nearly unnoticed near Grandin. King Bee Spring is inaccessible. Local history and sites associated with the world's largest timber producing town in 1870 are being forgotten and are largely unprotected. Archeological sites in the area have not been cataloged and some are being destroyed by land modification. Planning and zoning is needed to guide the future development of the area. The location and importance of old cemeteries have not been determined.

## COMPONENT NEEDS

Component needs include the following:

1. Change open and green space relationships.
2. Improve the condition of permanent vegetation.
3. Reduce soil erosion.
4. Establish natural areas.
5. Improve water quality and flow conditions.
6. Collect and remove junk, litter, and trash.
7. Provide, protect, and enhance forest and other natural vegetation.
8. Inventory and protect geological, archeological, and historic resources.

### Elements of Environmental Quality Plan

1. Improve diversity by:
  - a. Planting adapted tree species on 500 acres of delta land. Estimated cost - \$55,000.
  - b. Extending the area of shortleaf pines in the upland on 50,000 acres. Estimated cost - \$1,650,000.
  - c. Building 1,100 one-acre ponds. Estimated cost - \$3,025,000.
2. Fence tracts of land to exclude domestic animals. Estimated cost - \$1,550,000.
3. Plant vegetation screens around salvage lots and dumps. Collect scattered junk and automobiles. Estimated cost - \$20,000.
4. Purchase and preserve 5,800 acres, located in the south half of T25N, R3E, for dedication as a wilderness area. Estimated cost - \$718,000.
5. Improve scenic and water qualities of the Little Black River by fencing along the 106 miles of river which contains perennial flow. Estimated cost - \$2,382,000.



6. Close scour channels and remove obstructions in the Little Black River. Estimated cost - \$52,000.
7. Improve upland food and cover for wildlife by planting selected plant species. One thousand acres, located near proposed ponds. Estimated cost - \$55,000.
8. Plant and/or protect approximately 2,000 acres of forest corridors along drainage ditches and along the Little Black River. Estimated cost - \$669,000.
9. Dig 80 acres of pits along and connected to the drainage ditches. Estimated cost - \$240,000.
10. Conduct an educational campaign, promoting environmental concerns, through local news media. Estimated cost - \$50,000.
11. Provide fire protection for 146,400 acres of forest land. Estimated cost - \$14,000.
12. Establish historic or nature trails to inform and educate. Subjects include: the Grandin Sawmill; Indian Trails; interesting geologic formations or outcrops; or artesian wells. Estimated cost - \$52,000.
13. Extend the attraction of the area by development and preservation of historical and archeological sites. Estimated cost - \$694,000.
14. Make comprehensive studies of the archeology of the area to find and determine the importance of all sites used by man. Obtain easements on sites found to be important for preservation. Estimated cost - \$547,000.
15. Install pipes to outlet field and road drainage into the river and ditches. Estimated cost - \$880,000.
16. Manage and install good land practices on 174,000 acres. Estimated cost - \$3,846,000.
17. Plant vegetation on 6,800 acres of bottom land subject to swift flooding. Estimated cost - \$340,000.
18. Vegetate or otherwise protect 86 miles of eroding roadbanks containing an area of about 208 acres. Estimated cost - \$42,000.

19. Vegetate or otherwise protect approximately 20 miles of eroding streambank comprising approximately 80 acres. Estimated cost - \$4,981,000.
20. Plant adapted vegetation on approximately 4,500 acres of sand ridges. Estimated cost - \$370,000.
21. Provide solid waste disposal areas near Grandin, Fairdealing, and Naylor. Begin centralized waste collection. Estimated cost - \$48,000.
22. Build waste disposal plants and sewer systems for selected areas of concentrated dwellings and commercial operations for Grandin, Naylor, and Fairdealing. Estimated cost - \$595,000.
23. Initiate county planning and zoning.

A capital investment of \$32,985,000 and an annual operation, maintenance, and management cost of \$258,000 will be required for the installation of the Environmental Quality Plan.

#### Institutional Arrangements Available and Needed for the Implementation of the Environmental Quality Plan

Legal entities of government exist or the necessary authority exists for the organization of government entities to implement the EQ plan. They include township, county, and state government. Conservancy districts, watershed subdistricts, and drainage districts all have the power of eminent domain and taxation.

Several private, state, and federal programs are available providing financial assistance for land acquisition and the establishment of measures to implement the EQ plan. Included in the various programs are:

##### Private Programs

1. Missouri Chapter of Nature Conservancy - acquires and manages land of high ecological value.
2. Leo A. Dry Foundation - acquires small scenic areas.
3. Missouri Prairie Foundation - acquires native blue stem grass areas.

## Federal Programs

1. U.S. Department of Agriculture
  - a. Resource Conservation and Development - financial and technical assistance involving human and natural resources.
  - b. PL-566 - watershed protection and flood prevention.
  - c. Rural Environmental Conservation Program - provides cost sharing assistance to individual landowners for application of conservation practices.
  - d. Loans, advances, and grants to sponsoring local organizations.
2. U.S. Department of the Interior
  - a. Land and Water Conservation Funds - administered by the state - provides financial assistance for developing fish and wildlife habitat areas.
  - b. Pitman-Robinson Funds - provides for wildlife research and financial and technical assistance in developing wildlife habitat areas. Administered by the state.
  - c. Dingell-Johnson Funds - provides for fishery research and financial and technical assistance in developing fishery habitat areas. Administered by the state.
3. Environmental Protection Agency - provides grants for waste water treatment facilities.

## State Programs

1. Missouri Department of Conservation
  - a. Cooperative Forestry Program - provides tree planting stock and technical assistance.
  - b. Private land wildlife habitat improvement and pond management and stocking.
2. Department of Natural Resources, Division of Parks & Recreation.
  - a. Acquire and develop areas for the preservation of archeological resources.
3. Arkansas Game and Fish Commission
  - a. Provides wildlife habitat improvement, pond management and stocking.



#### 4. Arkansas Forestry Commission

- a. Provides tree seedling, at cost, and furnishes technical assistance in forest management and wildlife habitat improvement.

Technical assistance including educational and on-site assistance is available from:

1. Soil Conservation Service through local soil and water conservation districts.
2. Agricultural Extension Service.
3. Missouri Department of Conservation.
4. U.S. Forest Service.
5. U.S. Fish and Wildlife Service.
6. Arkansas Game and Fish Commission.
7. Arkansas Forestry Commission.

Although many programs for financial and technical assistance exist, higher priorities in other areas and limited resources available within the area will require additional funds for implementing the EQ plan.

#### Environmental Effects of the Plan

The installation of measures proposed by this plan would significantly alter the environmental values within the watershed. Reforestation of corridors along the ditches, streams, and other selected areas would provide green space suitable for hiking, nature study, and camping. Planting and furthering the spread of the native shortleaf pine to areas now predominantly oak-hickory forest would provide diversity and improve esthetics. Selective harvest management of forests would improve natural beauty. Better wildfire control would benefit wildlife and eliminate the unesthetic aftermath of a forest fire. These measures will all increase wildlife habitat value and will generally reduce soil erosion.

Protecting all eroding areas by mechanical measures or vegetation would reduce sediment carried by streams and deposits remaining after floods. Dust produced by wind erosion would be controlled. Flood peaks would be reduced by small amounts and the vegetated areas would add to natural beauty and provide additional wildlife cover. Field outlets in the delta would control erosion and sedimentation. Reducing loss of sediment, nutrients, pesticides, and other pollutants would improve water quality.

Purchase and dedication of the wilderness area would preserve existing environmental values. Such a wilderness area would attract visitors to the area. Access to wild or little used areas would provide recreation. Creation of access, demands that the areas be managed and maintained to preserve the quality for which the access was created.

Exclusion of livestock from perennially flowing parts of the river would stop trailing erosion, would increase wildlife cover within the protected area, and would preserve a natural corridor or green strip along the stream.

Wildlife plantings will provide food and cover to benefit wildlife, stop erosion, and add to the natural beauty.

Collection and provisions for solid waste disposal will beautify the area and will eliminate the possibility of pollution of area waters. The temptation to dispose of waste along county roads or at several uncontrolled sites will be halted. The removal of junk and worn out or wrecked automobiles will make the area a more desirable place to live by improving esthetics and removing breeding places for disease vectors.

Construction of sewage treatment plants and lines in towns where houses and businesses are concentrated will eliminate the possibility that water quality will be impaired.

Interested and important geological, archeological, and historic sites preserved and developed could provide educational experiences. These sites could be developed in conjunction with a park or natural area. Information gathered during development would add to the scientific knowledge of the area.

An ongoing educational campaign would help prevent littering and increase the awareness of the needs for environmental betterment.

Adoption of planning and zoning will identify and protect other environmentally sensitive areas. Guidance would be given to residential, industrial, and agricultural developments so that other environmental conflicts are recognized and properly resolved.

### PART III

#### DISPLAY OF ACCOUNTS

The following system of accounts illustrates a display of beneficial and adverse effects of the selected plan for the Upper Little Black Watershed on the components of National Economic Development and Environmental Quality Objectives and on the Regional Development and Social Well-being Accounts. This is consistent with the Water Resource Council's adopted Principles and Standards.



SELECTED PLAN  
NATURAL ECONOMIC DEVELOPMENT ACCOUNT  
UPPER LITTLE BLACK WATERSHED, MISSOURI

Dollars 1/

<u>Components</u>	<u>Measures of Effects</u> <u>Average Annual</u>	<u>Components</u>	<u>Measures of Effects</u> <u>Average Annual</u>
<b>Beneficial Effects:</b>		<b>Adverse Effects:</b>	
A. The value to users of increased output of goods and services.		A. The value of resources required for a plan.	
1. Flood Prevention	\$ 787,634	1. Floodwater retarding structures, multiple-purpose structure, and recreational development.	
2. Recreation	202,500	Project Installation (structural measures)	\$557,078
3. Utilization of unemployed and underemployed labor resources in project construction.	49,800	Project Administration	80,247
		O&M&R	82,340
<b>Total Beneficial Effects:</b>	<b>\$1,039,934</b>	<b>Total Adverse Effects:</b>	<b>\$719,665</b>
		<b>Net Beneficial Effects:</b>	<b>\$320,269</b>

1/ Annual values based on 5-5/8 percent interest for 100 year evaluation period.

August 1974

SELECTED PLAN  
ENVIRONMENTAL QUALITY ACCOUNT  
UPPER LITTLE BLACK WATERSHED, MISSOURI

Components

Beneficial and adverse effects:

A. Areas of natural beauty.

Measures of Effects

1. Create 755 acres of water in sediment pools of floodwater retarding reservoirs that will reduce to approximately zero acres as sediment accumulates over a 100-year period. These areas are largely in a forested landscape.
  2. Create a recreation lake with 298 surface acres within the scenic area of Ozark topography and vegetation.
  3. Permanently inundate 8 miles of perennial and approximately 3.5 miles of intermittent natural streams with reservoirs.
  4. Establish a 1,311 acre state park in connection with the B-9 structure.
  5. Reduce fire hazard on 90,277 acres of forest lands.
  6. Reduce the accelerated sediment and debris deposition on 7,711 acres of flood plain.
  7. Add to the aesthetics of the area with the application of land treatment practices such as tree planting and farm ponds.
1. Reduce erosion on 58,010 acres of upland by applying needed land treatment.
  2. Change water quality of Little Black River by reducing the annual yield of sediment by 49 percent.
  3. Reduce erosion on 2,390 acres of flood plain by 82 percent.

B. Quality consideration of water, land, and air resources.

Components

Measures of Effects

4. Improve forest condition on 9,400 acres of forested upland by applying forest management practices.
  5. Preserve the present location of Little Black River by reducing flood peaks.
  6. Increase duration of low flows by the storage and release from floodwater structures.
  7. Increase sediment during construction.
  8. Increased traffic in the recreational area accompanied by the usual noise, solid waste, and air pollution from 90,000 recreational visits annually.
- C. Biological resources and selected ecosystems.
1. Provide 755 acres of water in sediment pools of floodwater retarding reservoirs which will increase aquatic habitat for warm water fishery and waterfowl.
  2. Provide 49 miles of shoreline and 151 acres less than 2 feet deep around reservoirs that will approximate a littoral zone of standing water communities.
  3. Create 298 surface acres of flat water in recreation pool for warm water fishing.
  4. Permanently inundate 1,053 acres of terrestrial habitat conditions in reservoir areas.
  5. Wildlife and game habitat will be improved by land treatment practices like improved forest management, farm ponds, and some pasture improvements.

Components

Measures of Effects

6. Existing vegetation will be destroyed on the proposed structure sites disrupting upland game and other wildlife habitat until new vegetation is established. Some wildlife will be destroyed by construction equipment.
  7. Permanently inundate 8 miles of perennial and approximately 3.5 miles of intermittent streams having stream habitat.
    1. Convert 42 acres of pastureland, 277 acres of cropland, and 874 acres of forest land to dams, spillways, and reservoir pools.
    2. Permanently inundate 11.5 miles of existing streams.
  1. Increase regional funds available for improving the physical appearance of farmsteads on farms and business places in the region.
  2. Increase problems of traffic and congestion caused by a State Park development, into an otherwise "tranquil" area.
- D. Irreversible and irretrievable commitments.
- E. Other environmental effects.



SELECTED PLAN  
REGIONAL DEVELOPMENT ACCOUNT  
UPPER LITTLE BLACK WATERSHED, MISSOURI

Dollars 1/

<u>Components</u>	<u>Measures of Effects</u>		<u>Components</u>	<u>Measures of Effects</u>	
	<u>Average Annual</u>	<u>Rest of Nation</u>		<u>Average Annual</u>	<u>Rest of Nation</u>
I. Income:	Little Black Region	Rest of Nation	Income:	Little Black Region	Rest of Nation
Beneficial Effects:			Adverse Effects:		
A. The value of increased output of goods and services to users residing in the region.			A. The value of resources contributed from within the region to achieve the outputs.		
1. Flood Prevention	\$ 787,634	--	Project Installation	\$ 55,034	\$502,044
2. Recreation	202,500	--	Project Administration	2,310	77,937
3. The utilization of regional unemployed or underemployed labor resources.	49,800	--	O&M&R	82,340	--
4. Secondary	105,800	--			
Total Beneficial Effects:	\$1,145,734	--	Total Adverse Effects:	\$ 139,684	\$579,981
			Net Beneficial Effects:	\$1,006,050	-579,981

1/ Annual values based on 5-5/8 percent interest for 100 year evaluation period.

August 1974

SELECTED PLAN  
REGIONAL DEVELOPMENT ACCOUNT  
UPPER LITTLE BLACK WATERSHED, MISSOURI

<u>Components</u>	<u>Measures of Effects</u>		<u>Components</u>		<u>Measures of Effects</u>	
	<u>Little Black Region</u>	<u>Rest of Nation</u>	<u>Employment:</u>		<u>Little Black Region</u>	<u>Rest of Nation</u>
II. Employment:						
Beneficial Effects:				Adverse Effects:		
A. Increase in number and types of jobs.				A. Decrease in number and types of jobs.		
1. Employment in recreation service sector.	3 permanent semi-skilled jobs.	--		1. Loss in agricultural employment at project take area.	2 man years of agricultural employment.	--
2. Employment for project construction.	25 semi-skilled jobs for 12 yrs.	--				
3. Employment for project O&M&R.	3 permanent semi-skilled jobs.	--				
Total Beneficial Effects:	6 permanent semi-skilled jobs.	--		Total Adverse Effects:	2 permanent semi-skilled jobs.	--
	25 semi-skilled jobs for 12 yrs.	--		Net Beneficial Effects	4 permanent semi-skilled jobs.	--
					25 semi-skilled jobs for 12 yrs.	--



SELECTED PLAN  
REGIONAL DEVELOPMENT ACCOUNT  
UPPER LITTLE BLACK WATERSHED, MISSOURI

Components

Measures of Effects

Little Black  
Region

Rest of  
Nation

III. Population Distribution

Beneficial Effects:

Create 4 permanent semi-skilled jobs, and 25 semi-skilled jobs for 12 years in an isolated rural area which has experienced an 11% reduction in population in the last 20 years.

Adverse Effects:

-----

IV. Regional Economic Base and Stability

Beneficial Effects:

Provide drainage and flood protection on approximately 60,000 acres of delta land where agriculture is very significant in the economy. Create 4 permanent semi-skilled jobs and 25 semi-skilled jobs during installation in an area where 30% of the families have incomes less than the national poverty level.

SELECTED PLAN  
SOCIAL WELL BEING ACCOUNT  
UPPER LITTLE BLACK WATERSHED, MISSOURI

<u>Components</u>	<u>Measures of Effects</u>
A. Real Income Distribution:	1. Income of the project beneficiaries less than \$3,000 - 30 percent, \$3,000 to \$10,000 - 50 percent, and those with incomes greater than \$10,000 - 25 percent. Regional cost will be shared in about the same proportion as the benefits accrue.
B. Recreational Opportunities:	1. Provide for about 90,000 recreation days annually, primarily for local and regional area residents.
C. Life, Health, and Safety:	<div>1. Provide two percent level of flood protection. Reduce the threat of injury or loss of life that is directly associated with the velocity and depth of floodwater.</div> <div>2. Reduce the hazards to health caused by contamination of wells and pollution from sewage systems.</div> <div>3. Installation of the project will require the displacement of two families involving 10 persons.</div>

August 1974

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PROJECT MAP





WATERSHED WORK PLAN AGREEMENT

between the

SOIL AND WATER CONSERVATION DISTRICT OF BUTLER COUNTY, MISSOURI

SOIL AND WATER CONSERVATION DISTRICT OF CARTER COUNTY, MISSOURI

SOIL AND WATER CONSERVATION DISTRICT OF RIPLEY COUNTY, MISSOURI

LITTLE BLACK WATERSHED SUBDISTRICT

BUTLER COUNTY COURT

CARTER COUNTY COURT

RIPLEY COUNTY COURT

BUTLER COUNTY DRAINAGE DISTRICT NO. 10

NAYLOR DRAINAGE DISTRICT

MISSOURI DEPARTMENT OF NATURAL RESOURCES  
DIVISION OF PARKS AND RECREATION

(hereinafter referred to as the Sponsoring Local Organizations)

and the

SOIL CONSERVATION SERVICE  
UNITED STATES DEPARTMENT OF AGRICULTURE

(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organizations for assistance in preparing a plan for works of improvement for the Upper Little Black Watershed, State of Missouri, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, 68 Statute 666), as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organizations and the Service a mutually satisfactory plan for works of improvement for the Upper Little Black Watershed, State of Missouri, hereinafter referred to as the watershed work plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organizations and the Secretary of Agriculture, through the Service, hereby agree on the Watershed Work Plan, and further agree that the works of improvement as set forth in said plan can be installed in about 12 years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the Watershed Work Plan:

1. The Sponsoring Local Organizations will acquire such land rights as will be needed in connection with the works of improvement. The percentages of this cost to be borne by the Sponsoring Local Organizations and the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organizations</u> (percent)	<u>Service</u> (percent)	<u>Estimated Land Rights Cost</u> (dollars)
Structural measures for flood prevention	100	0	270,685
Multiple-purpose structure B-9 for flood prevention and recreational development.			
Payment to landowners for about 1,311 acres for recreational development. (Including appraisal fees)	50	50	327,750
Easements for flood prevention storage; about 154 acres.	100	0	19,250
Moving farmstead and camp buildings.	50	50	20,000
Berm for pipeline.	50	50	6,500
Legal fees, surveys, easement damage, and appraisals.	100	0	6,440

The Sponsoring Local Organizations agree that all land acquired or improved with PL-566 financial credit assistance will not be sold or otherwise disposed of for the evaluated life of the project except to a public agency which will continue to maintain and operate the development in accordance with the Operation and Maintenance Agreement.

2. The Sponsoring Local Organization assures that comparable replacement dwellings will be available for individuals and persons displaced from dwellings, and will provide relocation assistance advisory services and relocation assistance, make the relocation payments to displaced persons, and otherwise comply with the real property acquisition policies contained in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. The costs of relocation payments will be shared by the Sponsoring Local Organizations and the Service as follows:

	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Relocation Payment Costs</u> (dollars)
Relocation Payments	13.7	86.3	20,000

3. The Sponsoring Local Organizations will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to state law as may be needed in the installation and operation of works of improvement.
4. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organizations and the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Construction Cost</u> (dollars)
Structural measures for flood prevention.	0	100	5,852,700
Multiple-purpose structure B-9.	7.4	92.6	1,838,000
Facilities for recreational development multiple-purpose structure B-9.	50	50	671,820

5. The percentages of the engineering costs to be borne by the Sponsoring Local Organizations and the Service are as follows:



<u>Works of Improvement</u>	<u>Sponsoring Local Organization (percent)</u>	<u>Service (percent)</u>	<u>Estimated Engineering Cost (dollars)</u>
Structural measures for flood prevention.	0	100	585,400
Multiple-purpose structure B-9 for flood prevention and recreational develop- ment.	0	100	184,000
Recreation facilities (engineering service contract)	50	50	67,180

6. The Sponsoring Local Organizations and the Service will each bear the costs of project administration which it incurs estimated to be \$40,900 and \$1,379,900, respectively.
7. The Sponsoring Local Organizations will obtain agreements from owners of not less than 50 percent of the land above each reservoir and floodwater retarding structure that they will carry out conservation farm or ranch plans on their land.
8. The Sponsoring Local Organizations will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.
9. The Sponsoring Local Organizations will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.
10. The Sponsoring Local Organizations will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.
11. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.
12. This agreement is not a fund obligation document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the availability of appropriation for this purpose.

A separate agreement will be entered into between the Service and the Sponsoring Local Organizations before either party initiates work involving funds of the other party. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

13. The watershed work plan may be amended or revised, and this agreement may be modified or terminated only by mutual agreement of the parties hereto except for cause. The Service may terminate financial and other assistance in whole, or in part, at any time whenever it is determined that the Sponsoring Local Organizations have failed to comply with the conditions of this agreement. The Service shall promptly notify the Sponsoring Local Organizations in writing of the determination and the reasons for the termination, together with the effective date. Payments made to the Sponsoring Local Organizations or recoveries by the Service under projects terminated for cause shall be in accord with the legal rights and liabilities of the parties. An amendment to incorporate changes affecting one specific structural measure may be made by mutual agreement between the Service and the sponsor (s) having specific responsibilities for the particular structural measure involved.
14. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.
15. The program will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964 and the regulations of the Secretary of Agriculture (7 C.F.R. 15.1-15.12), which provide that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any activity receiving federal financial assistance.
16. This agreement will not become effective until the Service has issued a notification of approval and authorizes assistance.



THE SOIL AND WATER CONSERVATION DISTRICT  
OF RIPLEY COUNTY, MISSOURI

By: \_\_\_\_\_

Title: \_\_\_\_\_

Address: \_\_\_\_\_

Date: \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the governing body of the Soil and Water Conservation District of Ripley County, Missouri, adopted at a meeting held on \_\_\_\_\_.

\_\_\_\_\_  
(Secretary)

Address: \_\_\_\_\_

Date: \_\_\_\_\_

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THE SOIL AND WATER CONSERVATION DISTRICT  
OF BUTLER COUNTY, MISSOURI

By: \_\_\_\_\_

Title: \_\_\_\_\_

Address: \_\_\_\_\_

Date: \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the governing body of the Soil and Water Conservation District of Butler County, Missouri, adopted at a meeting held on \_\_\_\_\_.

\_\_\_\_\_  
(Secretary)

Address: \_\_\_\_\_

Date: \_\_\_\_\_

THE SOIL AND WATER CONSERVATION DISTRICT  
OF CARTER COUNTY, MISSOURI

By: \_\_\_\_\_

Title: \_\_\_\_\_

Address: \_\_\_\_\_

Date: \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the governing body of the Soil and Water Conservation District of Carter County, Missouri, adopted at a meeting held on \_\_\_\_\_.

\_\_\_\_\_  
(Secretary)

Address: \_\_\_\_\_

Date: \_\_\_\_\_

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DEPARTMENT OF NATURAL RESOURCES  
DIVISION OF PARKS AND RECREATION  
(Local Organization)

By: \_\_\_\_\_

Title: \_\_\_\_\_

Address: \_\_\_\_\_

Date: \_\_\_\_\_

The signing of this agreement was under the authority granted to the Director of the Missouri Department of Natural Resources.

BUTLER COUNTY COURT

By: \_\_\_\_\_

Title: \_\_\_\_\_

Address: \_\_\_\_\_

Date: \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the governing body of the Butler County Court, adopted at a meeting held on \_\_\_\_\_

\_\_\_\_\_  
(County Clerk)

Address: \_\_\_\_\_

Date: \_\_\_\_\_

RIPLEY COUNTY COURT

By: \_\_\_\_\_

Title: \_\_\_\_\_

Address: \_\_\_\_\_

Date: \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the governing body of the Ripley County Court, adopted at a meeting held on \_\_\_\_\_.

\_\_\_\_\_  
(County Clerk)

Address: \_\_\_\_\_

Date: \_\_\_\_\_

CARTER COUNTY COURT

By: \_\_\_\_\_

Title: \_\_\_\_\_

Address: \_\_\_\_\_

Date: \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the governing body of the Carter County Court, adopted at a meeting held on \_\_\_\_\_.

\_\_\_\_\_  
(County Clerk)

Address: \_\_\_\_\_

Date: \_\_\_\_\_

LITTLE BLACK WATERSHED SUBDISTRICT

By: \_\_\_\_\_

Title: \_\_\_\_\_

Address: \_\_\_\_\_

Date: \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the governing body of the Little Black Watershed Subdistrict, adopted at a meeting held on \_\_\_\_\_.

\_\_\_\_\_  
(Secretary)

Address: \_\_\_\_\_

Date: \_\_\_\_\_

BUTLER COUNTY DRAINAGE DISTRICT NO. 10

By: \_\_\_\_\_

Title: \_\_\_\_\_

Address: \_\_\_\_\_

Date: \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the governing body of the Butler County Drainage District No. 10, adopted at a meeting held on \_\_\_\_\_.

\_\_\_\_\_  
(Secretary)

Address: \_\_\_\_\_

Date: \_\_\_\_\_

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NAYLOR DRAINAGE DISTRICT

By: \_\_\_\_\_

Title: \_\_\_\_\_

Address: \_\_\_\_\_

Date: \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the governing body of the Naylor Drainage District, adopted at a meeting held on \_\_\_\_\_.

\_\_\_\_\_  
(Secretary)

Address: \_\_\_\_\_

Date: \_\_\_\_\_



Appropriate and careful consideration has been given to the environmental statement prepared for this project, and to the environmental aspects thereof.

Soil Conservation Service  
United States Department of Agriculture

Approved by:

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State Conservationist

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Date

# WATERSHED WORK PLAN

## UPPER LITTLE BLACK WATERSHED

Butler, Carter, and Ripley Counties, Missouri

Prepared Under the Authority of the Watershed  
Protection and Flood Prevention Act (Public Law  
566, 83d Congress, 68 Stat. 666), as Amended.

Prepared by: Soil and Water Conservation District of Butler County  
Soil and Water Conservation District of Carter County  
Soil and Water Conservation District of Ripley County  
Little Black Watershed Subdistrict  
Butler County Drainage District Number 10  
Naylor Drainage District  
Butler County Court  
Carter County Court  
Ripley County Court  
Missouri Department of Natural Resources, Division of  
Parks and Recreation

With assistance by:

U.S. Department of Agriculture, Soil Conservation Service

U.S. Department of Agriculture, Forest Service

June 1974

WATERSHED WORK PLAN  
UPPER LITTLE BLACK WATERSHED  
BUTLER, CARTER, AND RIPLEY COUNTIES, MISSOURI  
JUNE 1974

Summary of Plan

This work plan for watershed protection, flood prevention, and nonagricultural water management (recreation) was prepared by the Soil and Water Conservation Districts of Butler, Carter and Ripley Counties, Missouri; Little Black Watershed Subdistrict; Butler County Court; Carter County Court; Ripley County Court; Butler County Drainage District Number 10; Naylor Drainage District; and the Missouri Department of Natural Resources, Division of Parks and Recreation as cosponsoring local organizations. Technical assistance was furnished by the Soil Conservation Service and the Forest Service of the United States Department of Agriculture.

The project formulation of the Upper Little Black Watershed was developed concurrently with the Lower Little Black Watershed Project. The projects were analyzed jointly. Measures identified in both projects must be installed to achieve the flood prevention benefits described in this plan.

This 124,749-acre project is located in western Butler County, southeastern Carter County, and eastern Ripley County, Missouri. The primary problems in the watershed are floodwater, erosion, and sediment damages; and inadequate recreational facilities for the area. Measures included in this plan will reduce flood damages approximately 85 percent. Public recreation will be provided by the development of structure B-9 as a multiple-purpose floodwater and recreation site.

Land treatment measures planned include adequate treatment on 7,000 acres of cropland, 8,000 acres of pastureland, and 43,010 acres of forest land plus fire control measures on 90,277 acres of forest land. Additional land treatment will be installed that will partially protect other watershed areas. The total cost of land treatment measures is estimated to be \$750,100. These costs will be shared \$126,100 by PL-566 funds and \$624,000 by other funds.

Structural measures planned for installation in this plan include 19 floodwater retarding structures, and one multiple-purpose structure with associated recreation facilities.

The acquisition of land rights will require displacement of one family in the C-7 floodwater retarding structure site and one family above the flood pool of multiple-purpose structure B-9. This will cause displacement of one farming operation and a total of 10 occupants.

Twelve years will be required for installation of this project. Total estimated cost is \$12,034,185, of which \$10,394,892 will be borne by PL-566 funds and \$1,639,293 by other funds.

Land treatment measures will be maintained by the landowners. The floodwater retarding structures will be operated and maintained by the Little Black Watershed Subdistrict. The multiple-purpose structure B-9, its associated recreation facilities, and non-project cost items (two residences) will be operated and maintained by the Missouri Department of Natural Resources, Division of Parks and Recreation.

The total average annual cost of operating and maintaining the project is estimated to be \$82,340.

The total average annual benefits to the structural works of improvement are \$1,145,734 compared to an average annual cost of \$719,665, giving a benefit-cost ratio of 1.6:1.0. The project was evaluated for 100-years and amortized at 5-5/8 percent.



## WATERSHED RESOURCES - ENVIRONMENTAL SETTING

### Physical Resources

The Upper Little Black Watershed is located in Butler, Carter, and Ripley Counties in southeastern Missouri. Little Black River is a left-bank tributary of the Current River in the White River Basin. The watershed is in Land Resource Area 116, Ozark Highland, and the Ozarks Physiographic Province. The drainage area contains 124,749 acres. The watershed is about 25 miles long and is approximately 12 miles at the widest part. It is predominantly a rural area with a population of approximately 2,222. Towns located in the watershed are Hunter, population 129, and Grandin, population 243. These towns are approximately 110 air miles south and 20 air miles west of St. Louis, Missouri. Doniphan, population 1,850, and Poplar Bluff, population 16,653, are the trade centers for the area. They are located near the southwest and east boundaries of the watershed, respectively. 1/

The Little Black River is located in the Current River Subbasin of the Arkansas- White-Red water resource region. Two major divisions comprise the region. The region is primarily Land Resource Area 116, Ozark Highland, which consists of open and high hills with about 60 percent covered with forest, 20 percent used as cropland, and pasture occupying the remaining 20 percent. The other major division in the region is Land Resource Area 131, Southern Mississippi Valley Alluvium, which is located in the lower part of the basin and known locally as the delta area. The flat, plain area is used primarily for cropland. Upper Little Black Watershed is in the hilly portion of the region with outlet beginning approximately at the flatland portion.

The watershed has two major soil and water resource problem areas--upland and bottom land. The uplands comprising 94 percent of the watershed area have short, irregular, rolling to steep complex side slopes with narrow to moderately wide ridge tops which have nearly level to gently rolling slopes. The side slopes have excessive relief compared to normal relief on the ridge tops. The bottom lands which comprise 6 percent of the watershed are alluvial areas developed along the natural stream systems.

The dominant soils a/ on the narrow to moderately wide ridge tops of the uplands are of the Captina and Wilderness series. The dominant soils on the steep side slopes of the uplands are of the Clarksville and Doniphan series.

The Captina and Wilderness series consists of moderately well-drained soils with fragipans at a depth of 17 to 24 inches. Captina soils have silt loam surfaces and silty clay loam subsoils above the fragipan. Wilderness soils have cherty silt loam surfaces and very cherty silty clay loam subsoils above the fragipan.

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a/ The soil names used here are subject to change when the soil mapping and soil correlation is completed for the area. Soil series interpretation sheets are available.



The Clarksville series consists of deep acid somewhat excessively drained soils with very cherty silt loam surfaces and very cherty silty clay loam subsoils. The Doniphan series consists of deep, well-drained soils with very cherty silt loam surfaces and clayey subsoils.

The dominant soils in the bottom lands are of the Razort, Nolin and Newark series. The soils of the Razort and Nolin series are deep and well-drained. The Nolin soils have silt loam textures throughout. The Razort soils are silty or loamy throughout and they have an appreciable amount of cherty gravel in their subsoils. In places the gravel content makes up nearly 35 percent of the total volume. The soils of the Newark series are deep and somewhat poorly drained. They have silt loam textures throughout. Also included in the bottom lands are soils that have limited capacities for supplying moisture to plants because they contain more than 35 percent gravel or because they are very high in sand content.

A band of soils along the foothills at the escarpment, ranging from one-half to 5 miles or more in width, were developed in coastal plains materials. These soils occupy the area immediately below the Ozark Highlands and above the delta flood plains. The soils on the gentle slopes in this area have properties similar to those of the Captina soils. The strongly sloping and steep soils of this area have properties similar to those of the Clarksville soils.

The general soil map is being revised and will be available in March 1975. A detailed soil survey report is scheduled to be published in 1980. Individual soil survey maps are available for reference in the local field offices for most of the area.

Bedrock of lower Ordovician Age underlies the area. The Jefferson City formation is present in the southern third and the Roubidoux formation in the northern two-thirds. Through the central part of their courses, both the Little Black River and the Beaverdam Creek have incised through the Roubidoux into the Upper Gasconade formation. The Roubidoux formation is composed of beds of sandstone, chert, and interbedded fine-grained dolomite and cherty dolomite. The Jefferson City and Gasconade formations are coarse to fine-grained silty and cherty dolomites. The residual overburden varies greatly in composition and depth. Well logs show a range from 20 to 160 feet deep in the residuum. The percentage of chert and limestone rock float varies from a small amount of gravel mixed in the clays and silts to cobbly and bouldery gravels with few fines. Changes in composition may be abrupt laterally and vertically.<sup>a/</sup>

Local relief in the upland ranges from 40 to 80 feet in the southern section and 80 to 120 feet in the northern section. The relief at some areas adjacent to the Little Black River ranges from 160 to 180

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<sup>a/</sup> See Figure 4 - Geology Map.

feet. The drainage system is well developed with narrow ridges, stream divides, and moderate to steep valley slopes.

The highest elevation, approximately 800 feet above mean sea level, is in the extreme northern part of the watershed and along the west perimeter for approximately 6 miles. The lowest elevation is approximately 289 feet.

The watershed is in the humid region with annual precipitation averaging 47.01 inches. Mean temperature varies from 37.5 degrees in January to 79.9 degrees in July. A maximum annual precipitation of 75.24 inches occurred in 1927. The minimum annual rainfall was 31.83 inches in 1954. The climatic conditions of the watershed are summarized as follows:

Mean annual temperature	58.8 degrees
Maximum temperature	114 degrees
Minimum temperature	-24 degrees
Last killing frost in spring (avg.)	April 7
First killing frost in fall (avg.)	November 2
Length of growing season (avg.)	209 days

Average distribution of precipitation is as follows:

Season	Months	Precipitation Inches
Spring	March, April, May	13.81
Summer	June, July, August	11.97
Autumn	September, October, November	10.82
Winter	December, January, February	10.41

The known mineral resources are limited to manganese and iron. <sup>2/</sup> Manganese generally occurs northward from an east-west line 1 to 2 miles south of Hunter, Missouri. "In spite of the wide spread occurrence of manganese in southeastern Missouri, the very small size and low grade of known deposits, and the poor experience to date with attempts to make acceptable concentrates by mechanical methods, do not encourage optimism for significant future production." <sup>3/</sup> The entire watershed is within the area of occurrence of limonite iron ore. Several small prospect pits are within the watershed but prospecting has not been done for many years. "The brown ores of the Ozarks are accumulations of limonite, also derived at least in part from sulfides, that have been mined extensively but have only a minor and decreasing importance today." <sup>3/</sup>

"Clay is mined in the region by A. D. Willis and Sons, Industries, Poplar Bluff, Butler County for the production of red and buff face bricks. The main clay pit is located at the company's brick plant in the



northeast part of Poplar Bluff. The company also mines clay from two other pits; one about two miles southwest of Poplar Bluff and the other in Stoddard County. The Willis Company has been the only continuous producer of clay in the region for many years. A small amount of white burning clay was mined during the period 1959-1962 from a pit 4 miles southwest of Poplar Bluff by the Ozark Development Company. The clay was shipped to Ohio for the manufacture of chinaware. Active mining ceased about 1962; however, the company still controls the property. Other small deposits of white burning clay are known in Butler County and several were mined in the late 1800's and early 1900's. Present clay resources are limited and would not support a major brick manufacturing industry." 33/

"Chief sources of sand and gravel in the region are the alluvial deposits on the Black, Current, and St. Francis Rivers and their tributaries. Sand resources and perhaps limited amounts of gravel are present in the southeast lowland area of Butler County, extreme southeastern Ripley County, and northern Clay County, Arkansas. A drawback to these deposits is that they are overlain by appreciable amounts of clay and that they contain lignite." 33/ Only one sand and gravel pit was observed in the Little Black River Watersheds, this abandoned pit being located in the lowlands southwest of Harviell. Present sand and gravel production in the area is from three producers along the Black River in Butler County.

Much of the watershed area is underlain by stone deposits, though stone meeting specifications for high quality aggregate is not formally found. Stone production is not presently occurring in either of the watersheds.

Groundwater is good quality and present at moderate depths in the upland areas. Yields range from 150 to 600 gallons per minute, and dissolved solids are usually less than 1,000 p.p.m.

At the present time there are very few irrigation developments within the watershed area; however, there is potential in the immediate flood plain area. Irrigation water from shallow wells is available in the extreme lower portion of the flood plain. Irrigation water along the main stream in the upper portion above Highway V would be available from the Little Black River. The water supply in both areas would be of suitable quality for irrigation uses.

The flood plain soils are generally well suited to irrigation, provided adequate drainage systems are developed and floodwater hazards are reduced. Crops most readily adaptable and most suitable for irrigation are corn, sorghums, soybeans, rice, and cotton.

Towns in the watershed, Grandin and Hunter (unincorporated), are small and have relatively stable populations. There are no industries using large amounts of water, and the demand for additional water supplies is not great. These towns and rural residents rely on shallow wells for water supplies. Groundwater supplies are adequate in both quality and quantity.

The drainage pattern is dendritic with major streams flowing to the southeast. The Little Black River begins in Carter County near Hunter, Missouri, and flows southeastward. Beaverdam Creek, the major tributary, joins Little Black approximately 2 miles north of Highway 160. From Highway 160 the river course turns southwest, flows across the delta, and joins the Current River in Clay County, Arkansas, near Success. Other tributaries to Little Black River include South Prong Little Black River, North Prong Little Black River, and Flat Creek. They are unmodified, well-defined natural streams that have intermittent flows.

Streams which serve drainage areas of less than 15 square miles are generally intermittent. As drainage is accumulated or lower elevations are reached, Little Black becomes a perennial stream. The channel throughout the upland region has a gravel bottom, clear water, and a pool and riffle pattern. As the river leaves the upland, the stream changes character. A transition section is present in the area from approximately 1 mile above to below U.S. Highway 160. In this section, the water becomes more turbid, deeper, and generally more sluggish. The channel bed changes from gravel to fine sand to silts and clays and begins to meander. The meandering nature is maintained from this point to the outlet of the Lower Little Black Watershed in the Current River approximately 26 miles downstream.

Water quality information for the Upper Little Black Watershed was obtained from two sources. A water quality and stream gaging station is maintained near Naylor on Little Black River. During the spring of 1974 the Midwest Research Institute (MRI) generated additional data at five stations in the project area. Samples were taken on three dates-- January 29, March 12 and 13, and May 1, 1974.

The water quality data from the Naylor station has been compared to a similar station at Doniphan on the Current River. <sup>4/</sup> Current River is a larger stream of which Little Black is a tributary. The Doniphan station is located only a few miles above the Current River's confluence with Little Black. The following parameters were compared: maximum temperature, fecal coliform, maximum dissolved oxygen, pH, dissolved nitrates and ammonia, maximum phosphates, dissolved solids, total hardness, and maximum color. It is concluded from the comparison of these parameters that water of the Current is superior to that of Little Black at these reporting stations. Values of all of the above parameters were in favor of better water quality for the Current River.



A more complete information of water quality in Little Black River drainage is provided by the MRI information. Eighteen water quality parameters were assessed on samples from each of the three trips. Some of the parameters examined were: dissolved oxygen, ammonia and organic nitrogen, total phosphate, total alkalinity, total hardness, total dissolved and suspended solids, turbidity, temperature, pH, BOD, and total and fecal coliform. All of the above parameters met existing state and federal water quality standards except total phosphates exceeded federal standards of .1 mg/liter in all stations except three during the March sampling. Because no known sewage effluents enter the river system, it is speculated that this source of phosphates is a result of geologic leaching. The fecal coliform count met present Missouri standards at all times but exceeded federal standards for primary contact recreation in two sampling instances. Fecal occurrence is attributed to animal and not human wastes. Turbidity for the Upper Little Black project had only two sampling instances where it equaled or exceeded 25 (Formazin Units).

Wetlands, as defined in "Wetlands of the United States," Department of Interior, Fish and Wildlife, Circular C-39, do not exist in Upper Little Black Watershed.

#### Economic Resources

The economy of the watershed is based largely on agriculture. Most farm operations are diversified livestock and grain farms. Employment in forest and forest-product industries is also important in the area.

There are 1,016 landowners in the watershed. Of these, 362 have holdings classified as farms which average 292 acres. Farms by size are as follows:

SIZE OF FARMS	NUMBER OF FARMS
0 - 40 acres	159
41 - 80 acres	52
81 - 120 acres	38
121 - 160 acres	31
161 - 320 acres	51
320 acres plus	31
TOTAL	362

In the 5-year period between 1964 and 1969, the trend has been toward fewer farm owners with larger farms. <sup>4/</sup> Most of these farms are family-operated units and 90 percent are owner-operated. Very little outside help is used with less than 6 percent of the farms using more than 150 man-days of hired labor each year. In fact, a 1969 Ripley County census showed that 63 percent of the farmers worked off the farm for some portion of the year and 34 percent worked at least 200 days off the farm. <sup>5/</sup>



Forest land is the predominant land use, occupying approximately 93,562 acres or 75 percent (of the watershed). Hardwood stands make up 91 percent of this area and consist of the oak-hickory and bottom land hardwood types. The remaining 9 percent consists of shortleaf pine and mixed oak-pine stands. Twelve percent (14,970 acres) of the watershed is in pasture, 8 percent (9,980 acres) is in cropland, and 5 percent (6,237 acres) is miscellaneous land. Land use in the flood plain consists of cropland, 57 percent; pastureland, 24 percent; forest land, 14 percent; and miscellaneous land, 5 percent.

Most cropland in the watershed is located in the flood plain associated with the stream system in the upland. In the bottom lands where 84 percent of the cropland is located, the primary crops are soybeans, corn, and alfalfa. Typical per acre yields to be expected in the watershed are 25 bushels of soybeans, 60 bushels of corn, 2-5 tons of alfalfa, and 35-40 bushels of wheat.

Because most of the bottom land is affected by floods, yields vary widely from year to year. Since most croplands are located within the problem area, farm income is severely affected.

The market value of all agricultural crops sold as shown on a per farm basis is \$4,000 to \$7,000 below the state average for Missouri counties and \$5,000 below the state average for Clay County, Arkansas. 4/ Fifty-two percent of all farms have sales of less than \$2,500 annually.

Most feed grains and hay produced in the area are marketed in the form of livestock, while soybeans is the major cash crop. Market outlets are available through farmer-owned cooperatives, local livestock auctions, slaughter facilities, and regional outlets outside the watershed. These facilities are adequate for the limited marketing needs of the agricultural sector of the watershed.

Local markets are good for saw logs, stave bolts, pine posts, poles, decking, flooring, railroad ties, walnut veneer logs, and wood chips. Charcoal wood, pulpwood, pallet, and handle blank material are also marketable.

There are 5,767 acres of land in public ownership consisting of the National Forests of Missouri (Mark Twain and Clark, 3,115 acres), and the state land, 2,652 acres. The remaining forest land is held by an estimated 485 private owners. The average size private forest ownership is approximately 190 acres.

Land values range from \$100-\$200 per acre in the upland and \$300-\$600 per acre in the bottom land. The increased demand for small tracts of land in the upland to be used for home sites and hunting areas is exerting an upward influence on land values, and they are expected to increase.

The watershed is served by more than 150 miles of county and timber access roads and about 40 miles of farm-to-market state roads. Many lesser roads have low water crossings and are frequently impassable for short times. Major highways are U.S. 160 and U.S. 67. Several interstate trucklines serve the area and railroad facilities are furnished by the Missouri Pacific Railroad.

The watershed is economically depressed. 4/ It had a relatively smaller working age population, a lower labor force participation rate, and a higher unemployment rate than the U.S. as a whole. Most people employed were working for manufacturing or retail trade industries. This region has a higher percentage of workers engaged in retail trade than the nation as a whole, and the proportion of agricultural employment in the area was about three times as high as the U.S. average.

Median income in the counties was well below the U.S. average of \$9,950. 4/ In 1969, Carter County had the lowest median income, only \$3,858. Mean income in all counties was higher than the median income, yet still far below the national average. The mean family income in Ripley County was only \$5,131 which was 46.6 percent of the U.S. average. Carter County had the highest mean family income among the four counties, \$7,482 or 69.0 percent of the U.S. value of \$10,999.

The poverty level for a family of four was set at \$3,745 by the Department of Commerce. 4/ The percent of families with income less than the poverty level in the Little Black River counties was two to three times higher than the nation as a whole. Carter County, the best of the four counties, still has 24.2 percent of its families living under the poverty level. In contrast, more than one of every three (or 36.4 percent) families in Ripley County was suffering from poverty.

Local governments provide public goods and services such as education, police and fire services, street and road maintenance, etc. The quality and quantity of these public goods and services are represented by the expenditures per capita in any particular year. A static one-time analysis of revenues and expenditures per capita, which have been frequently employed to measure the output of local governments, may be considered informative and serve as a useful indicator. The latest official document available is the Census of Governments, 1967. 6/ A comparison using 1967 data was made of three counties in the Little Black River region to the U.S. average; statistics for Butler County are not available.

While per capita general revenues for all county governments in the U.S. in 1967 totaled \$72, Carter County had only \$17, about 23.6 percent of the U.S. average. 4/ Ripley County was the highest among the three, yet still 37.5 percent below the national level. Revenues from taxes were about \$10 per capita for the counties in the region, as compared to \$33 in the nation. The low tax revenues resulted primarily from a low tax base as reflected by the productivity and income comparisons described previously. As a consequence, expenditures per capita were also very low since balanced budget has traditionally been stressed by county governments.



The watershed is located in the Ozarks Development Region (OZARKA) and the Ozark Foothills Regional Planning Commission. A resource conservation and development (RC&D) project application is being prepared which will include all of the watershed area. The Ozark Foothills Regional Planning Commission has endorsed this application and taken the lead in providing information to sponsors of the project. It is also coordinating collection of information and helping organize the RC&D Steering Committee.

### Fish and Wildlife Resources

Differences in the physiographic nature of the watershed are reflected in the distributional relationships of the aquatic fauna. 7/ Upper Little Black Watershed lying north of U.S. Highway 160 lies within the Ozark Uplands physiographic region. 4/ This area includes all the higher gradient, cooler, headwater reaches.

The aquatic habitat in this area is typified by rapidly flowing water with many short pools and well-defined riffles. The stream bottom is composed mainly of fine to coarse chert fragments. During times of flooding, the fragments are washed up into piles forming an unstable pool-riffle pattern. Sand and silt are found on the bottom only in the quieter, deeper pools and backwater areas. Aquatic vegetation in this part of the stream is limited to water cress (*Nasturtium officinale*) in areas strongly influenced by springs, water willow (*Dianthera americana*) along the margins of the larger pools and riffles, and coontail (*Ceratophyllum* sp.) and water milfoil (*Myriophyllum* sp.) along the margins of the larger pools. Species of fish found in this part of the stream typically prefer cool (maximum 83° F), 8/ silt-free water and include the smallmouth bass, rockbass, northern hogsucker, and several species of darters and minnows. However, warmer microhabitats exist in this portion of the watershed which provide niches for species such as the blackspotted topminnow and green sunfish.

The fish fauna of the Little Black River is extremely varied due to the diversity of aquatic habitats. A total of 68 species have been collected from the watershed by the Missouri Department of Conservation for the period 1853-1969 at 15 collection sites. 4/ Seining studies conducted by MRI included 22 species, six of which were not included on the list tabulated by the Missouri Department of Conservation. 4/ This brings the total known species to 75. A total of 117 species known to occur regionally in adjacent watersheds have also been listed as possibly occurring in the Little Black River. 4/

Of major concern is the presence of seven species designated rare or endangered by Missouri. 4/ 34/ Two of the seven species listed were included in early Department of Conservation collections on the Little Black Watershed. 7/ These are the harlequin darter and the pugnose minnow. None of the seven were found in recent MRI collections. However, their presence in the watershed is certainly possible.

Plankton samples were collected from each of the nine sampling stations during April 15-18, 1974. 4/ Mean number of net plankton for the Upper Little Black River and its tributaries thus ranged from 27-130/liter. These counts are so low as to be a negligible consideration in this study. No true or distinctive plankton community exists in the streams because of the limiting factor of current. Those few organisms encountered were derived from headwater ponds, springs, quiet backwaters of streams, or had been dislodged from the bottom or submersed objects. 9/

Samples of stream benthos were collected at each of the nine sampling stations. 4/ A total of 40 taxa of benthic macroinvertebrates were identified from the watershed. 4/ Clifford identified a total of 57 taxa for six Ozark streams. 10/ Considering the larger area involved in Clifford's study, the results shown on the Little Black compare favorably. This is largely due to the diversity of habitats available in this watershed.

The Little Black Watershed is within geographic range of 11 species of salamanders and 13 species of frogs and toads. 4/ 11/

There are no known amphibians which are considered rare or endangered either nationally or by the States of Arkansas or Missouri which occur in this watershed.

The reptiles of this geographical area consist of six species of lizards, 15 species of turtles, and 29 species of snakes. 4/ 11/ The large tracts of undeveloped land, the abundance of diverse habitat, and the numerous water areas contribute to high reptilian populations.

In the delta, the populations of turtles would be considerably higher than those found in the uplands. Conversely, lizards would probably be more abundant in the forested uplands. Populations and species diversity of snakes will probably be highest in the areas adjacent to the ditches of the delta and the Little Black River channel.

There are 270 species of birds which possibly occur in the Little Black Watershed. 4/ Of these, 111 are migrants, 37 are winter residents, 68 are summer residents, and 54 are permanent residents. 12/ 13/ Although the watershed is within the Mississippi Flyway, waterfowl use of the watershed is limited. Wood ducks, however, do nest in the area, making use of standing timber adjacent to water courses.

There are 58 species of mammals which possibly occur in the watershed. 4/ 14/ Of these, 13 species are considered furbearers and five species are classed as game animals in Missouri. Those classed as furbearers include the opossum, raccoon, badger, longtailed weasel, mink, spotted skunk, striped-skunk, coyote, red and gray fox, bobcat, beaver, and muskrat. The game animals are whitetailed deer, swamp rabbit, eastern cottontail, fox and gray squirrel.



Deer, rabbit, quail, and squirrel populations in the uplands are low when compared to state averages. <sup>15/</sup> Quail and rabbit populations in the foothills are considerably higher. Cropland is mixed with woodlands and provides plentiful food and edge areas. The bottom land populations of most wildlife species are highest adjacent to areas of good cover, namely ditch banks. Quail and rabbits are abundant along these banks.

Within the Little Black Watershed gray fox, grey squirrel, turkey, and deer are found in the heavily forested uplands, while deer, red fox, cottontail rabbit, and quail are found in the areas more interspersed with crop, pasture, and forest land. Swamp rabbits as the name implies, would be found in the bottom land areas subject to frequent flooding.

Three species of animals considered rare or endangered nationally which may occur in the watershed are the southern bald eagle, Indiana bat, and eastern cougar. <sup>16/ a/</sup>

There are several other species considered rare or endangered by Missouri which may occur in the watershed. These are listed, along with their status and other remarks. <sup>4/</sup> It should be understood that some species listed as rare or endangered in Missouri or Arkansas may not necessarily be considered so elsewhere, because Missouri or Arkansas may be a peripheral part of their native range. And, since geographical range is controlled by various limits of tolerance, minor changes in habitat may drastically affect species populations.

### Recreational Resources

In 1970, the Missouri Inter-Agency Council for Outdoor Recreation produced a revised Outdoor Recreation Plan. This plan consisted of an inventory of recreation resources and prediction of recreational needs through the year 1990. The plan divides the state into multi-county regions.

Little Black River Watershed lies near the center of the south half of the Ozark Foothills Region which is comprised of Butler, Ripley, Carter, Wayne and Reynolds Counties. Approximately 88 percent of the recreation land in the Ozark Foothills Region is owned or managed by the federal government. Eleven percent is controlled by state agencies, and the remainder is privately owned.

The Ozarks are a major recreation area. Currently, a large part of the recreational resources are used by nonresidents. Access and facilities for outdoor activities are becoming more difficult to obtain. With the richness of the soil and high land values in the delta area, little provision has been made for large-scale recreational developments.

<sup>a/</sup> The Eastern Cougar (Felis concolor cougar) subspecies probably could not be separated even if one were found in Missouri because this part of the state historically is believed to have been an area of inter-grade among the four races - cougar, coryi, hyppolestes, and stanleyana.



The Department of Interior, through the National Park Service, is developing a National Scenic Riverway along part of the Current River. This strip-like park includes local points of interest; such as, Big Spring near Van Buren, Missouri. Preservation of nature and public use are goals of the riverway.

The Upper Little Black Watershed is a remote scenic area containing qualities valued for outdoor recreation. Large hills, steeply sloping into valleys, provide many panoramic scenes. The river and its tributaries form a scenic and quaint natural Ozark stream. The Little Black River is one of the watershed's major recreational resources. It is a scenic, spring-fed, free-flowing stream which flows rapidly down through the uplands then slows and meanders through the flood plain between tree-lined banks. Similarly, the tributary streams are exceptionally scenic; opportunities exist for fishing, nature study, swimming and wading in the deeper holes, aesthetic enjoyment, and canoeing during the high flows. Spring flowerings, summer greenery, fall foliage, and winter beauty all contribute to the type of natural setting sought for recreational experiences.

Recreational resources except fishing on the Little Black River and hunting on private lands are listed on the following pages: 4/

The existing public recreational areas are used extensively. The use of state parks has exceeded capacity in past years which has led to establishment of a capacity for each park by the Missouri Department of Natural Resources, Division of Parks and Recreation. The National Forests of Missouri, the state forest, and other facilities operated by the Missouri Department of Conservation are open to the public. On private areas, access is by permission of the owner or operator. There is extensive use of upland and flood plain areas on private lands for hunting turkey, quail, and deer.

Water-based recreation is limited to streams, the Missouri Department of Conservation community lakes, Clearwater and Wappapello Reservoirs, farm ponds, and private lakes. The river and its tributaries are largely bordered by private lands and the limited number of access sites are important to fishermen and canoeists. Water quality is good during normal flows. During periods of runoff, sediment creates turbidity which reduces water quality for a short period of time.

#### Archeological and Historic Values and Unique Scenic Areas

The director of the Missouri Archeological Survey and the staff of the State Historic Preservation Officer have been consulted regarding archeological sites within the Little Black Watershed.

Research in an adjacent area has revealed that for the past 10,000 years the Little Black River area has been a locus of human activity, but little information is available on the Upper Little Black River Watershed due to lack of intensive survey in that area. Based on

PRINCIPAL RECREATIONAL AREAS IN OR NEAR

LITTLE BLACK WATERSHED

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	<u>Acreage</u>			
	<u>Land</u>	<u>Water<sup>a/</sup></u>	<u>Primary Uses</u>	<u>Managing Agency</u>
<u>Within a 25-Mile Radius of Grandin, Mo.</u>				
Ripley Community Lake	90	90	Fishing	Missouri Department of Conservation
Ozark National Scenic Riverway	55,000	Current River access	Fishing, Canoeing, Scenery	National Park Service
Lake Wappapello State Park	41,850	400	Picnicking, Camping, Fishing, Waterfowl Hunting and Observation	Missouri State Park Board & Missouri Department of Conservation
Wappapello Reservoir and Wildlife Area	36,196	7,800	Picnicking, Camping, Fishing, Waterfowl Hunting and Observation	Corps of Engineers
Buffalo Creek Recreational Area	(Mark Twain National Forest)		Camping, Swimming, Picnicking	U.S. Forest Service
Hawes Memorial Recreational Area	(Mark Twain National Forest)		Camping, Picnicking, Swimming, Fishing, Boating	U.S. Forest Service
Doniphan Country Club	NA	NA	Golf, Swimming	Private Club
Poplar Bluff Country Club	NA	NA	Golf, Swimming	Private Club
<u>Within a 50-Mile Radius of Grandin, Mo.</u>				
<u>Missouri</u>				
Duck Creek Wildlife Area	4,195	1,773	Fishing, Hunting	Missouri Department of Conservation
Sam A. Baker State Forest	17,782	-	Hunting	Missouri Department of Conservation
Sam A. Baker State Park	4,858	40	Fishing, Boating, Camping, Cabins	Missouri State Park Board
Deer Run State Forest	102,602	-	Hunting	Missouri Department of Conservation
Peck Ranch Wildlife Refuge	22,565	-	Hunting, Wildlife Production	Missouri Department of Conservation
Eleven Point River Trout Management Area	-	5.5 miles of stream	Fishing	Missouri Department of Conservation
Bradyville Wildlife Area	268	-	Waterfowl Hunting	Missouri Department of Conservation
Mingo Wildlife Management Refuge	21,663	NA	Fishing, Hunting, Nature Observation	U.S. Bureau of Sport Fisheries and Wildlife
Clearwater Reservoir	16,992	1,650	Camping, Fishing, Boating	U.S. Corps of Engineers
Fremont Tower Picnic Ground	3	NA	Picnicking	Private
McCormick Lake Recreational Area (part of Mark Twain National Forest)	15	11	Picnicking, Fishing, Swimming, Boating	U.S. Forest Service

PRINCIPAL RECREATIONAL AREAS IN OR NEAR

LITTLE BLACK WATERSHED

(Cont'd)

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	Acreage		Primary Uses	Managing Agency
	Land	Water <sup>a/</sup>		
<u>Within a 50-Mile Radius of Grandin, Mo.</u>				
<u>Missouri (Concluded)</u>				
Clark National Forest, Butler County <sup>b/</sup>	46,723	15	Picnicking, Camping, Fishing, Hiking	U.S. Forest Service
Mark Twain National Forest <sup>b/</sup>	68,783	96	Picnicking, Camping Fishing, Hiking	U.S. Forest Service
Carter County			Picnicking, Camping Fishing, Hiking	
Ripley County	88,405	363	Picnicking, Camping Fishing, Hiking	U.S. Forest Service
Ben Cash Wildlife Area	982	3 miles river access	Hunting, Fishing	Missouri Department of Conservation
Coon Island Access	5	438 ft. of stream	Fishing, Canoeing	Missouri Department of Conservation
Doniphan Towersite	10	-	Picnicking, Fire Control, Hunting	Missouri Department of Conservation
Fish Access	4	stream, 560 ft.	Fishing, Canoeing	Missouri Department of Conservation
Grandin Towersite	160	-	Picnicking, Fire Control, Hunting	Missouri Department of Conservation
Greenville Ford Access	3	stream, 200 ft.	Fishing, Canoeing	Missouri Department of Conservation
Hilliard Access	1	stream, 200 ft.	Fishing, Canoeing	Missouri Department of Conservation
Turkey Pen Tract	160	-	Hunting	Missouri Department of Conservation
Little Black State Forest	2,322	1-1/4 mile of river	Camping, Picnicking, Fishing, Hunting	Missouri Department of Conservation
Lone Hill Towersite	13	-	Picnicking, Fire Control	Missouri Department of Conservation
Poplar Bluff State Forest	950	1/4 mile of river	Camping, Picnicking	Missouri Department of Conservation
<u>Arkansas</u>				
Black River State Wildlife Area	20,000	shallow water	Waterfowl and small Game Hunting	Arkansas Game and Fish Commission
Mammoth Spring State Park	NA	NA	Camping, Picnicking	Arkansas State Park Dept.

<sup>a/</sup> Acres unless otherwise given.

NA - Not available.

<sup>b/</sup> Clark National Forest and Mark Twain National Forest are now designated as National Forests of Missouri.



knowledge concerning human occupation of the Lower Little Black Watershed, it can be assumed that the cultural resources are as extensive, perhaps more extensive, in the Upper Little Black River Valley.

The Little Black River Archeological District has been nominated by Mr. James L. Wilson, Director of the Department of Natural Resources and Missouri's State Historic Preservation Officer, to the National Register of Historic Places. This district includes that part of the watershed which lies south of an east west line located approximately three miles north of U.S. Highway 160.

From historical documents it is known that there are several grist mill sites, a military cemetery, early homesteads, and a historic road located within the Little Black River Watershed. Early French trappers and traders used the road, called the Nachitoches Path, as early as the first quarter of the 18th century. It subsequently became the route of pioneers settling the Red River area and served as a route for movement of the Cherokee Indians during the Jackson Administration. It became an official military road in 1834 and was the major route of invasion for General Price's army during the Missouri Campaign of the Civil War. It is worth mentioning that the area around Grandin was the scene of an intensive lumber enterprise. <sup>19/</sup> In 1890, Grandin had the largest sawmill in the world at that time. The mill processed 90 railroad cars of logs per day with an annual production of 70 million board feet. <sup>22/</sup> An earlier (1870) sawmill was located on Brushy Creek and owned by Mr. J. B. White.

Mrs. Pennington <sup>19/</sup> has reported on the location of a well-known Indian trail in Carter County between the Current and Black Rivers. Near Van Buren, it follows the north bank of the Current River just below the summit of the ridges. The trail can be seen near the mouth of Six Mile Hollow and again where it ascends Granite Quarry Mountain. Thus, not only was the Little Black River area important in prehistoric times but it played a major role in the growth of the United States during the Westward Expansion.

Sources of information for the historical survey include: "The National Register of Historic Places," <sup>17/</sup> and more recent announcements of designated historic places that have been reported in the Federal Register. <sup>18/</sup> Other sources include county histories, <sup>19/</sup> <sup>20/</sup> <sup>21/</sup> town histories, <sup>27/</sup> and the "Historic Sites Catalogue." <sup>23/</sup> In addition, the Federal Register, <sup>18/</sup> reviewed for more recent information, provided no listings. However, an old family graveyard is located on land owned by the Missouri Department of Conservation in SE 1/4, Sec. 12, T23N, R4E.

#### Soil, Water, and Plant Management Status

The flora of the watershed is diverse. <sup>4/</sup> In the delta, in association with the hydric environment along the Little Black River and the ditches, plant communities are probably representative of the original vegetation, if not in age, at least in species composition. Here there is often an



overstory of oaks, gums, and bald cypress which form a canopy over a diverse and lush subordinate shrub and forb community.

The overstory of the foothills and the Ozark uplands, for the most part, are typically oak-hickory climax. <sup>4/</sup> In the higher portion of the drainage, which is typically the more arid portion of this area, shortleaf pine becomes a prominent species in the present timber stands. Undoubtedly, this is a consequence of past fire history and the effects of secondary succession.

Timber harvest throughout the drainage, at least on the privately-owned lands, appears to have been essentially unregulated. Probably, through a system of harvesting the most desirable trees over a relatively long-time span, the species composition of many of the stands has shifted to a preponderance of the less desirable varieties, such as blackjack oak and others which have either a slow growth rate or poor form which makes them less desirable for commercial purposes.

Areas of the uplands, and to a degree in the delta, which have been cleared, now have a vegetative composition of predominately broomsedge (*Andropogon virginicus*) and shrub and tree regeneration. This circumstance is often the result of overgrazing or from the abandonment of "worn out" agricultural land. Other areas which have been cleared of native vegetation are now in improved pasture, and where conservation practices have been observed, appear productive. <sup>4/</sup>

Proper treatment of much of the land is not being practiced. Many farm units are uneconomical, and committed factors of production are employed inefficiently. The land on which soil, water, and related plant resources are adequately protected in the watershed as of June 30, 1973, was reported as 33,693 acres. <sup>26/</sup> The acreages of land adequately protected by land use are as follows:

<u>Land Use</u>	<u>Land Adequately Protected</u> (acres)
Forest Land	20,823
Pastureland	6,970
Cropland	2,270
Other (including wildlife land)	3,630

The uplands are inherently low in fertility and require proper management to fully utilize their potential. Some minor changes in land use are also needed. Although the percent of cropland in the uplands is low, most of it is better suited to other uses.

The bottom land is moderate to high in fertility. Land use is mostly cropland except in areas where severe flood problems exist. These lands need flood protection and drainage. Approximately 84 percent of the bottom land area has a seasonal high water table with some temporary surface ponding in the winter and spring. Land treatment practices

needed include drainage mains and laterals, surface field ditches, land smoothing, crop residue management, and an adequate fertility program.

The watershed lies within the Soil and Water Conservation Districts of Carter, Butler, and Ripley Counties, Missouri. These districts have been actively promoting land treatment measures. Landowners in the watershed have signed 184 cooperative agreements with the three soil and water conservation districts. The agreements cover approximately 50 percent of the area. Conservation plans have been developed with 108 cooperators, and approximately 20 percent of the planned practices have been applied. These measures are generally accepted by landowners; however, the land treatment programs need to be accelerated throughout the watershed.

### Land and Water Management

Upland land use is primarily pasture and forest land. Many pastures have been overgrazed and are infested with weeds and brush. Although progress has been made, much of the pastureland needs renovation and proper management plans. Many upland farms are too small for efficient operations, and limited capital has restricted the ability of the landowners to install needed land treatment measures.

Approximately 75 percent (93,562 acres) of the watershed is in forest cover. Hydrologic condition is adequate on 34 percent of the area. More intensive management is needed on the remaining forest land. This existing condition is due primarily to the lack of management, wildfires, and intentional burning. Individual fires often destroy large areas due to the lack of fire suppression equipment. Public acceptance of the need for fire prevention continues to be a problem as evidenced by the amount of intentional burning that occurs each year.

Much of the existing forest land is poorly managed. The result is a low stocking of poor quality material and undesirable species. This has lead to the landowners' placing a low economic value on such areas. Productivity and economic yield should be restored through sound multiple use management practices such as more intensive fire control, approved harvesting techniques, reforestation and open land tree plantings, and more equitable forest land tax laws.

The clearing of forest land in bottom land sites for production of farm crops has been a common practice. This practice depletes the forest resource when there is a need for lumber and related forest products. The forest resource also has considerable value for environmental corridors, aesthetic appeal, wildlife habitat, watershed protection, air and water pollution abatement, recreation, hunting and fishing.

Flood plain lands are used primarily for cropland, and fertility is generally high. The primary land treatment needs are for diversions, surface field ditches, land smoothing, proper fertilization, and management plans. Frequent flooding of the flood plain and the economic status of the landowners have limited application of the needed measures. Most hay and feed grain crops are produced in the flood plain lands. Many of the upland landowners depend on these for feed to support their livestock operations.

### Floodwater Damage

Flooding is a major problem in the bottom land along the main stem and tributaries. Floods occur an average of three to four times each year, with 70 percent occurring during the growing season. Major floods have



occurred in 16 of the last 20 years. The 100-year flood plain inundated by the Little Black River and upland tributaries is estimated to be 7,711 acres. Excess water restricts the timing of planting, tillage, harvesting, choice of crops, and efficient utilization of labor and equipment.

Low returns from this area cause landowners to be reluctant to invest in practices; such as, diversion terraces or adequate fertilization for long-term gains. Flooding on the flood plain has forced the conversion of cropland to pastureland. Reaches of the streams where the most severe flooding occurs are primarily in pasture or forest although this land has potential for producing high yields of grain crops. The added cost attributed to flooding can no longer be absorbed by small farmers for crops which have become highly competitive on the market.

Two major areas within the watershed are affected by flooding: (1) a long, relatively narrow flood plain of 1,430 acres adjacent to Beaverdam Creek in Butler and Ripley Counties, and (2) a wider, flat area of 6,281 acres along Little Black River, extending 30 miles from above the town of Grandin in Carter County through Ripley County to the outlet in Butler County.

A typical flood took place in May of 1961. Approximately 3,000 acres were flooded causing \$50,000 damage within the watershed. This was estimated to be a 2-year frequency storm.

The most damaging flood of recent years occurred in March 1964 when 10.10 inches of precipitation were recorded at Doniphan, Missouri, over a 3-day period and 7.95 inches were recorded at Poplar Bluff, Missouri, over the same period. This flood resulted from a storm in excess of 50-year frequency. Other recent storms of major significance occurred in 1965, 1966, and 1969.

An estimated 32,543 acres in the 100-year flood plain of Lower Little Black were identified including 8,356 acres in Arkansas. This makes a total flood plain in both projects of 40,254 acres along the Little Black River and its tributaries.

Values of flood plain lands vary from \$200 to \$600 per acre, depending upon the degree of hazard and inherent fertility. Except for fences, farm roads, and a few isolated farm buildings, there are no significant agricultural improvements or other properties subject to damages.

Flood plain reaches used in these studies and their locations are as follows:



REACH	LOCATION
Ia	North Prong Little Black River Above Structure B-9 Flood Pool.
I & II	Little Black River Between Structure B-9 and Beaverdam Creek Junction.
IIIa	Beaverdam Creek Above Structure A-3 Flood Pool.
III	Beaverdam Creek Between Structure A-3 and Little Black River Junction.
IV & V	Little Black River Between Beaverdam Creek Junction and the Floodway Diversion Structure.
VI & VIII	Little Black River from Reach V to Near Arkansas State Line. <u>a/</u>
IX & X	Little Black River from Reach VIII to Current River. <u>a/</u>

a/ Reaches are located in the Lower Little Black Watershed.

Total direct agricultural and nonagricultural floodwater damages were studied for floods up to and including 100-year frequency. Average annual dollar damages by category are as follows:

Reach	Crop and Pasture	Sediment & Erosion	Other Agricultural	Non-Agricultural
Ia	7,258	9,619	3,406	775
I	16,142	16,142	5,676	1,295
II	5,846	5,242	2,219	165
IIIa	3,254	22,392	1,651	991
III	6,077	10,109	2,516	1,511
IV	7,033	2,488	1,161	292
V	28,495	--	1,948	521

Indirect damages; such as, interruption of travel, rerouting mail routes, losses sustained by businessmen in the trade area and similar losses, are estimated to be \$16,422 annually. These damages are summarized in Table 5.

Average annual acres flooded inside the watershed total 4,297. In the identified flood plain in the Lower Little Black Watershed an average 29,616 acres are flooded annually.

Floodwaters pose a direct threat to the lives of people living adjacent to or traveling within the flood plain. Hazardous conditions exist from streams rising rapidly and flooding roads. U.S. Highway 160, a major highway in Ripley County, is blocked by water over the road from 5-year frequency storms. Other highway locations subject to flooding are: Highway 21 bridge in Grandin, Highway B bridge northeast of Grandin, Highway NN and Highway K in Ripley County.

The floodwaters also contribute to the problems of pollution. They create a hazard to the health and well-being of the people in the flooded area through flooding of domestic wells and waste disposal systems.

#### Erosion Damage

Erosion rates from various watershed land uses are as follows:

Land Use	Sheet Erosion (Tons Per Acre Per Year)
Cropland	7.2
Idleland	4.0
Pastureland	3.0
Forest Land	4.2
Other	4.0
Average Sheet Erosion	4.3
Average Gross Erosion	4.6

Roadside and other erosion is estimated to yield the equivalent of 1.4 tons per watershed acre per year. Streambank erosion in the uplands yields the equivalent of 1 ton per watershed acre per year. The average gross erosion including streambank is 4.6 tons/acre/year. Flood plain scour is a severe problem. Thirty-one percent of the flood plain has received damage to production ranging from 19 to 54 percent. Numerous scour channels depreciate agricultural land, and sheet scour removes the plow layer. The average annual erosion damage is estimated at \$33,040. Erosion of the watershed soils depreciates their value and reduces their productive capacity. Flood-induced erosion damage retards the installation of agricultural practices; such as, drainage and land shaping, and thus acts as a restraint to efficient and maximum productivity of lands subject to flooding.

### Sediment Damage

Sediment and coarse debris, which are damaging flood plain lands, range in size from silt and clay to sand, fine gravel, and cobbles. Damage to production ranges from 2 to 48 percent. The deposits are generally sand and gravel splays although vertical accretion and natural levees are present. Coarse deposits are normally confined to areas near the river banks and to scour channels. Deposition damages an estimated 1,551 acres annually.

Overbank flows increase turbidity and degrade the water resource. Flood damages from sediment-laden water are greater than those from clear-water flooding. Sedimentation is apparent after each flood, and all vegetation, both crop and natural, receive sediment deposited on the plant. Natural levees prevent return flow of water to the stream on receding flood stage or block natural runoff from fields.

Swamping damage is in limited areas. This damage is present where water is trapped by formation of natural levees and in some places in scoured areas of the flood plain.

Sediment is a problem in drainage ditches. It contributes to shoaling and losses of capacity and induces growth of vegetation because of fertility.

The estimated annual yield of sediment in Little Black River at the project boundary is 96,907 tons. The average annual deposition damage is estimated to be \$32,952.

### Recreation

Many of the recreational areas in the outlying region are managed for the public, but within the watershed boundaries, nearly all the forest, water, and open space areas are in private ownership. Access to these areas is generally by permission. In particular, public access to streams is limited to a few points where roads cross the streams; even at these locations, access is restricted and inconvenient. No public facilities are available on the lower part of the river, and even private recreational developments are lacking. Only one public access point is present on the 57 miles of stream length in the watershed. The lack of adequate access and facilities reduced the use of land and water-based recreational resources in the watershed.

The 1970 Missouri Outdoor Recreation Plan shows a need for additional fishing, hiking, picnicking, and playfield areas for users from Butler, Ripley, and Carter Counties. Population within a 50-mile radius is 75,000.

By 1980, demand is expected to exceed supply for several recreation activities in Butler, Carter, and Ripley Counties. Much of this demand will emanate from Poplar Bluff in Butler County, the largest trade and population center in the region. 4/



There are three general observations that can be drawn from data concerning recreational resource problems; the primary need in both the watershed area and the region is for water-based recreation, particularly fishing and swimming opportunities. Two major lakes (Clearwater and Wappapello) are located within 45 minutes to 2 hours driving time. Use of these facilities regularly exceeds capacity, and consideration has been given to limiting the number of recreation users. The National Scenic Riverway on the Current River is also experiencing use-pressures that exceed capacities. Second, hunting (small game, big game, and waterfowl) opportunities are in great demand by area residents. It has been estimated that by 1980, nearly 300,000 acres will be needed for hunting in Butler, Carter, and Ripley Counties alone. 4/ An important recreational resource problem is the preservation and enhancement of hunting lands. Finally, the need is increasing for open, scenic areas with facilities for playfields, picnicking, and bicycling.

National Forest Service lands within a 50-mile area of the watershed is approximately 204,000 acres. Expansion of existing facilities and further development of new facilities will be needed to satisfy some of the needs especially for lower developed recreation activities. These will be quite important in satisfying needs for state and national recreation activities. These resources will not fulfill local and regional needs, because of increasing state and national demands. National Forest Service facilities also will not be distributed to meet needs of local areas influencing the Little Black area.

Natural streams, forest lands, open access, and scenic landscapes are abundant resources in the project area. Local citizens have identified a need for recognition of these resources and making some of them available for public use.

### Fish and Wildlife

Wildlife-carrying capacities of the highland region are limited. Extensive dense stands of pole-size timber are present, and interspersions of vegetation is not extensive. Overgrazing by domestic livestock detrimentally affects wildlife vegetation. Inherent low soil fertility also affects plant diversity and nutritional qualities of forage and mast.

The foothill region supports a good population of upland wildlife. A higher resident population causes public usage to be more restrictive than in the highlands.

Present land uses in the foothills support the excellent habitat conditions. Continued encouragement and consideration will need to be given to protect these conditions. Pressures and incentives could build for conversion of land uses that detract from this existing interspersions of vegetative types.



Availability of stream fishing access is a problem over the entire watershed. There are approximately 43 miles of perennially flowing stream and only one public access site (Ripley County Road K) exists.

Seven species of fish included on Missouri's list of rare and endangered species are thought to occur in this watershed. 4/ Collections have actually been made by the Missouri Department of Conservation of the harlequin darter and the pugnose minnow. 7/ Little is known of the goldstripe darter, except that it is known to occur in Missouri from only one small spring in Butler County. The other listed species have been collected in this general region of the state and may likely occur within this watershed. None of the species listed as possibly occurring in this watershed are included on the U.S. list of threatened wildlife. 16/

There are nine mammals, 14 birds, one amphibian, two reptiles, and 23 plant species considered rare or endangered by Missouri which may occur in the watershed. 4/ Two mammals and one bird in the state listed group are considered threatened nationally. 16/ In most instances, the reduction in populations of these species is due to reduction of habitat. For instance, the swamp rabbit, king rail, Swamison's warbler, and Bachman's warbler have been adversely affected by swamp drainage and removal of the original delta forest. The raptorial species which are considered rare or endangered have probably been reduced through the action of cumulative, persistent insecticides rather than through reduction of habitat.

### Water Quality

Present problems related to water quality are the high concentration of phosphorus in the watershed streams and turbidity which is normally associated with floodwaters. Samples taken April 30, 1974, contained concentrations of this phosphorus which exceeded the maximum recommended limit of 0.1 mg/liter. 27/ The high phosphorus level increases the rate of eutrophication. Turbidity reduces plant growth, the ability of sight-feeding fish to capture prey, and general stream aesthetics.

### Economic and Social

There are 1,016 landowners in the watershed. Of these, 362 have holdings classified as farms which average 230 acres in size. The estimated market value of all agricultural crops sold on a per farm basis averages \$4,000 to \$7,000 below the state average for the Missouri counties, and \$5,000 below the state average for Clay County, Arkansas. The trend for the period 1964 to 1969 was to fewer farm owners with larger farms. This trend has probably not changed in more recent years.

Most of the farms are family-operated units and 90 percent owner-operated. Less than 6 percent of the farms use more than 150 man-days of hired

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labor each year. In fact, up to 63 percent of the farmers work off the farm on part-time jobs during a portion of the year.

In 1970 the region's unemployment rate was as high as 7.8 percent compared to the U.S. rate of 4.4 percent. <sup>4/</sup> It also has a relatively smaller working age population, a lower labor force participation rate, and a lower payroll per employee in all sectors than the U.S. as a whole. The percent of families with income less than the poverty level in the Little Black River counties was two to three times higher than the nation as a whole.

During 1970 the manufacturing sector accounted for 21.1 percent of the total employment, while retail trade, personal and business services, and agriculture made up 20.1, 19.8, and 11.4 percent, respectively. Comparing these to national averages, manufacturing is 4.8 percent lower, retail trade is 4.1 percent higher, personal and business services are 0.8 percent lower, and agricultural-based employment is 7.7 percent higher than the national averages. These data thus suggest that the lack of jobs in the manufacturing trades is the primary factor depressing the employment opportunities in the area. <sup>4/</sup>

The financial support for fire and police protection by local government is significantly smaller in the Little Black River region than is provided by the average of local governments in the States of Arkansas or Missouri. The average dollars spent per capita by local governments for police protection varies from \$4.29 per capita in Butler County to \$1.40 in Carter County, compared to \$12.59 for the average of all local governments in Missouri and \$5.08 in Arkansas. <sup>4/</sup>

Similarly, local government finances for fire protection is substantially below the state averages. In Butler County, local governments spend about \$2.22 per capita annually for fire protection, while in Ripley County only \$0.13 per capita is provided. These figures are considerably lower than the average for all communities in Missouri and Arkansas, \$6.43 and \$3.04, respectively. <sup>4/</sup>

In summary, this area is economically depressed due to the low income from farming activities, lack of industrial-related employment opportunities, and below average governmental expenditures on public goods and services.

## PROJECTS OF OTHER AGENCIES

Upper Little Black Watershed is located in the White River Basin. The works of improvement planned for Upper Little Black are included as a part of the comprehensive Type II study of needed improvements for the White River. The drainage area controlled and acre feet of flood storage provided by Upper and Lower Little Black Watershed Work Plans are essentially the same as that used in the evaluations for the White River Type II Study.

The Corps of Engineers has proposed tie back levees along the Current and Little Black Rivers in the 10 to 15-year plan of the Type II study which would complement this project. No activities are under way to implement authorization of the levees.

In the development of the comprehensive basin study for the White River Basin a major tributary reservoir was considered at Fairdealing, Missouri. This reservoir would inundate agricultural areas, provide no protection for areas upstream and be in conflict with an upstream watershed project. After detailed analysis and meetings with the local interests, this reservoir was eliminated from the 10-15 year plan. The reservoir was retained in the long range plan as an alternate in the event that a watershed project was not developed. This arrangement resulted from joint studies by the Corps of Engineers and the Soil Conservation Service.

No other proposed projects of state or federal agencies will be affected by the works of improvement proposed in the Little Black Work Plans.



## PROJECT FORMULATION

From 1961 to 1964 the Soil and Water Conservation District of Ripley County, Missouri, promoted a series of interest meetings to discuss the potential of a PL-566 project on the Little Black River. These were held at the following schools within the watershed: Grandin, Missouri; Pine Valley, Missouri; Fairview, Missouri; Spell, Missouri; Naylor, Missouri; and Success, Arkansas. The district also sponsored two public tours into Arkansas to inspect watersheds under construction.

Early in 1964, the PL-566 application was submitted to the Governor of Missouri. Sponsors included the Carter County Court; Ripley County Court; Butler County Court; Butler County Drainage District No. 10; and Soil and Water District Boards of Ripley County, Carter County, and Butler County, Missouri. The Governor approved the application on June 30, 1964.

The following groups also endorsed the project: Van Buren Lions Club, Van Buren Chamber of Commerce, East Carter County Chamber of Commerce, Doniphan Lions Club, Van Buren Rotary Club, City of Grandin, Ripley County Chamber of Commerce, Doniphan Kiwanis Club, City of Doniphan, Ripley County Farm Bureau, City of Naylor, Butler County Farm Bureau, Naylor Special Road District, Poplar Bluff Chamber of Commerce, and Clay County Soil and Water Conservation District, Arkansas.

A watershed subdistrict was organized for the Missouri portion of the Little Black drainage area in 1964 and has provided leadership in the development of the watershed work plan. The delta area in Ripley County organized a Circuit Court Drainage District in 1968. Clay County Soil and Water Conservation District and Western Clay Drainage District submitted a separate application in August 1964, on the portion of Little Black in Arkansas. The sponsors requested that applications be combined and planned concurrently.

A preliminary investigation was prepared in 1965 and presented to the sponsors on July 26, 1965. The sponsors showed strong interest and requested the Soil Conservation Service to proceed with developing a watershed work plan. Planning authorization was granted in February 1966 by the Administrator of the Soil Conservation Service.

The watershed planning staff gathered field data on various alternatives to meet the goals and objectives of the sponsors. A series of meetings were held with the sponsors and interested public to discuss the field data and various alternatives for formulating land treatment and structural programs to solve their soil and water problems. Some of these meetings were held as follows:



## Project Formulation

April 20, 1966	Poplar Bluff, Mo., with steering committee
October 18, 1967	Doniphan, Mo., with steering committee
February 28, 1968	Neelyville, Mo., public meeting with sponsors, farmers, landowners
August 12, 1968	Toured watershed with Missouri Department of Conservation
September 10, 1968	Poplar Bluff, Mo., with steering committee
September 12, 1968	Corning, Arkansas, with steering committee
October 25, 1968	Poplar Bluff, Mo., with Corps of Engineers, Memphis District representatives, Arkansas River Basin Staff, and Area Conservationist
October 25, 1968	Naylor, Mo., Soil and Water Conservation Districts of Butler, Carter and Ripley Counties, Corps of Engineers
March 17, 1969	Doniphan, Mo., with steering committee
September 8, 1969	Neelyville, Mo., with steering committee
September 9, 1969	Meeting with Butler Drainage District No. 10
September 10, 1969	Meeting with Western Clay Drainage District
September 11, 1969	Meeting with Naylor Drainage District
November 14, 1969	Jefferson City, Mo., with Missouri Department of Conservation
March 6, 1970	Jefferson City, Mo., with Missouri Department of Conservation
March 18, 1970	Meeting with steering committee at Doniphan to review mitigation alternatives
July 8, 1970	Harviell, Mo., meeting with Butler County Soil and Water Conservation Board members and Butler Drainage District No. 10 Board members to review levee location
October 5-7, 1970	Poplar Bluff and Doniphan, Mo., meeting with sponsors
January 25, 1971	Jefferson City, Mo., with Missouri Department of Conservation

## Project Formulation

March 2, 1971	Neelyville, Mo., with steering committee
March 2-5, 1971	Field trip and conference with Missouri Department of Conservation
March 3, 1971	Tour of structure sites with Butler County Soil and Water Conservation District and watershed trustees
March 4, 1971	Field trip and conference with sponsors and landowners, Ripley County, Mo., and Clay County, Ark.
March 22-23, 1972	Naylor, Mo., field trip and conference with Naylor Drainage District Board
March 19, 1973	Naylor, Mo., public meetings to discuss proposed projects and impacts
March 20, 1973	Success, Arkansas, public meetings to discuss proposed projects and impacts
March 21, 1973	Neelyville, Mo., public meetings to discuss proposed projects and impacts

The project formulation of the Upper Little Black Watershed was developed concurrently with the Lower Little Black Watershed Work Plan. Flood routings, evaluations, and effects were all developed and formulated to determine the effects on the total Little Black Watershed. Since project formulation for both projects was done jointly, the following writeup with discussion of the decisions, regarding flood prevention as developed, will apply for both projects. Formulation decisions regarding drainage and recreation are discussed as applicable in individual project plans. Prior to the reorganization of the Missouri State Government in mid 1974, the Missouri State Park Board was a sponsor of this project. The Department of Natural Resources, Division of Parks and Recreation, is the sponsor under the reorganization.

### Objectives

Specific objectives which have been agreed upon by the sponsoring local organizations and the Soil Conservation Service are as follows:

1. To install needed land treatment as the first increment of the project. The goal for the 12-year project period is 50 percent of that needed in the watershed.
2. To improve hydrologic conditions, particularly on forested lands in the watershed.

3. To shift marginal or submarginal farmlands to more profitable or socially beneficial uses.
4. To reduce average soil loss in the upland from 4.3 to 3.1 tons per acre per year.
5. To reduce sediment and scour damage to flood plain soils.
6. To reduce flow of upland runoff and provide an approximate 2-year or greater level of protection for areas now in agricultural production.
7. To provide additional public water-based recreation.

In formulating the watershed project, the first increment was considered to be the installation of land treatment measures on private lands by the landowners. The next increment of development included identifying potential floodwater retarding sites. This involved studying many possible sites in the watershed with various combinations of structures. Close coordination between the watershed planning staff and local leadership resulted in the selection of 25 structures for the combined watersheds, controlling 52 percent of the total Little Black drainage. In many cases, this involved studying several alternate locations for each site and also included discussion with the landowners involved. A more detailed discussion on various alternatives follows later in this section.

The combination of land treatment measures and floodwater retarding structures would not provide adequate protection to meet the objectives of the sponsors for developing an adequate level of flood damage reduction. Even though a large percentage of the upland area is controlled by floodwater retarding structures, the Little Black would still overflow frequently in the delta area. The level of protection, without improving the Little Black River or providing other floodway channels through the delta, would be less than a 1-year storm and would probably induce damage, due to the longer period of flooding along the Little Black River in the delta area. Therefore, several alternatives were studied for providing additional channel capacity across the delta area. In selecting the alternative for providing channel improvement, the following factors were considered:

1. Cost
2. Effects on fish and wildlife habitat
3. Land ownership patterns
4. Location of present drainage ditches
5. Bridge locations
6. Other physical and social barriers



A number of different locations were studied for a flood prevention channel, and, of these, it was determined that the best location would be along the approximate alignment of drainage ditch No. 3. In locating and designing this channel, which will begin as a diversion for flood-water, care was given to minimize fish and wildlife losses and also to restore the construction areas to a good condition. The diversion channel was planned in order that base and low flows would continue to flow in the present natural Little Black River. This was done by planning a water control structure at the junction of the natural channel and the entrance to the diversion channel.

The level of drainage desired by the sponsors is a system that will make possible the production of field crops; such as corn, soybeans, wheat, and cotton. This is accomplished by designing the system to remove approximately 1 inch of rainfall in 24 hours.

The drop structures in ditch 3 have been planned to hold water at each structure to maintain a stable bottom and provide water for fishery. Each structure will have a port to permit fish to travel from one structure impoundment to another.

Recreation, as a purpose, was investigated during work plan development. Reservoir sites suitable for including storage for recreational development are available. A group of interested citizens representing civic interests in Doniphan reviewed the suitable structure sites in Upper Little Black Watershed and decided on the B-9 location and aesthetic assets as the most desirable because of its accessibility. The group contacted the Missouri Department of Conservation who indicated that they would not be interested in a recreation lake development. The group then contacted the Missouri Department of Natural Resources, Division of Parks and Recreation who expressed an interest in developing the B-9 site as a state park with water-based recreation.

Several reservoirs of various sizes ranging from the minimum for recreational development (240 acres) to the maximum were studied. Due to physical limitations at the site, the most feasible size was at elevation 440 making a recreational pool of 298 acres. This was agreed on and local sponsors will purchase and furnish approximately 120 acres of land through local donations to the State Park Board to establish the park. The park board will purchase the remaining land needed for the park.

The Missouri Department of Natural Resources, Division of Parks and Recreation analyzed the recreational potential and determined that this was a satisfactory proposal. It studied alternative development potential and selected the proposed plan based upon the physical characteristics of the site. The recreational development will be administered as a state park having statewide significance but is particularly needed to serve regional and local needs within a 1-hour (50-mile) driving time. Population within a 1-hour driving time is approximately 75,000 people. A large or extensively developed park would not be required for a population of this size, but should offer a choice of day or overnight-use facilities.



## Environmental Considerations

In formulating both projects, structure locations and designs were selected to minimize the displacement of people, the closing of roads, and other disruption in the lives of local residents. Considerations were given to maintaining base flow in the natural Little Black River so as to preserve this stream in its present state. When studying the alternatives, the erodability of the soils and other physical limitations were considered in determining the need of erosion control structures, both in the channel and as erosion control devices for local inlets. Consideration was also given to modify the structural features for flood prevention to minimize damage to fish and wildlife resources and, if possible, to enhance fish and wildlife habitat. Several alternatives to replace upland wildlife habitat and fisheries involved were developed and thoroughly discussed with the local sponsors and the Missouri Department of Conservation.

The following alternatives were developed for discussion with sponsors. Plans were to list one or a combination of these in the work plan and carry them out in the operational stage.

### Ditch No. 3

1. Spread spoil, seed ditch side slopes, berm, and side slope of spoil. Leave 30-foot top bare for native vegetation.
2. Stack spoil. No spreading. Leave bare for native vegetation.
3. Same as 1, except plantings in place of bare area. Fence areas where ditch is along pasture.
4. Substitute other areas acre for acre (10 acres per mile, est.)
5. Ten acres per mile turn-over to Missouri Department of Conservation for planting and maintenance.

### Other Ditches

1. Work from one side, and that side planted to grass-legume mixture--not grazed or mowed until after July 15. Berm and ditch side slope not included.
2. Where working both sides of ditch, treat one side same as for ditch No. 3, alternatives 1, 2, 3, 4 or 5. Other side, plant to grass-legume mixture. Not grazed or mowed until after July 15. Berm and ditch side slope not included.

Alternative 1 for ditch No. 3 was selected as the method for replacing wildlife habitat in all counties. Drainage districts in Ripley and Clay Counties selected alternative 1 under Other Ditches for minimizing wildlife habitat losses. Drainage District No. 10 in Butler County selected

acquiring scattered blocks of land for managing as wildlife areas or mitigation measures for loss of habitat on small ditches.

Large American Beech trees (*Fagus grandifolia*) located on the left bank (southside) of the Little Black River in Sec. 24, T23N, R4E, will be preserved. These trees are comparatively rare in Missouri, and the diversion structure and channel were relocated approximately 500 feet west of the original alignment to avoid the trees.

To insure that the Little Black River will maintain its approximate low flow characteristics, four of the floodwater retarding structures in Upper Little Black Project (A-3, B-9, C-7, D-2) and one in Lower Little Black Project (F-11) are planned with ports to release water and help maintain stream flows during drought periods. To further insure that existing conditions continue on the Little Black River after the project is built, two major scour openings in the left bank (Gaines Slough, Sec. 36, T23N, R4E, and the opening in Sec. 24, T22N, R3E) will have pipes of 25 c.f.s. and 100 c.f.s. capacity respectively installed in the closure levees.

### Alternatives

The following paragraphs review the alternative methods considered in project formulation to reduce damages due to flooding. One alternative is the use of the land within its capabilities and treatment of 65 percent of the land according to its needs. Another is no treatment at all. Any change from the present land use towards a less intensive use would favor public ownership. Some alternatives are wildlife preserves, recreational areas, parks, and tree farms.

The following are alternatives to the proposed plan for the selected objectives:

- A. A system of 39 floodwater retarding structures in the uplands along with 4.4 miles of levee on the left side of the Little Black River, 6 levee closures on the Little Black left bank, 61 miles of multiple-purpose channel modification, and 29.4 miles of channel clearing and snagging on the Little Black River.
- B. A system of 25 floodwater retarding structures and no channel modification to carry floodwater except in the existing Little Black River.
- C. A system of eight large structures in the upland of Little Black along with the 85 miles of multiple-purpose channel modification proposed in the work plan.
- D. Install a system of 25 floodwater retarding structures in the uplands and straighten the Little Black River to carry a 5-year frequency flow from the point that it enters the delta flood plain (Sec. 24, T23N, R4E) to the Current River.



- E. Twenty-five structures in the upland with a diversion at Gaines Slough (Sec. 36, T23N, R4E) where the Little Black now overflows at a major break to flood lowlands. At this point divert a 5-year frequency flow from the Little Black over to ditch No. 3; enlarge ditch No. 3 along its present alignment to the State line and to its junction with ditch No. 1, then continue on the alignment of ditch No. 1 to Little Black, straighten Little Black from the Current River to the junction of ditch No. 2 just above the State line.

#### Alternative A

The first alternative included development of resource conservation plans on 65 percent of the watershed with the needed land treatment, 39 floodwater retarding structures in the uplands, 4.4 miles of levee on the left side of the Little Black River, six levee closures on the Little Black left bank, 61 miles of multiple-purpose channel modification, and 29.4 miles of channel clearing and snagging on the Little Black River. Average annual flood damage reduction would be 90 percent. Sediment pools would permanently inundate 1,740 acres of agricultural and wildlife habitat land; retarding areas would periodically flood 4,000 additional acres. Clearing of 2,030 acres of woodlands would be necessary. Reservoirs would inundate 12 miles of perennial stream and 1 mile of intermittent stream. Fish and wildlife habitat would be reduced or eliminated along 29 miles of the Little Black River. This alternative was selected during preliminary project investigation. However, 15 of the floodwater retarding structures were not feasible because of physical limitations. The levee proposed along the left side of the Little Black River would create ownership problems and would require purchase of 23 acres of land. This alternative could be implemented under PL-566 authority at an initial cost of \$33,130,000.

#### Alternative B

Land treatment as described in "A", 25 single-purpose floodwater retarding structures and no channel modification. Prolonged flows from floodwater retarding structures would induce damages which would offset damage reduction in other areas. Permanent inundation of 1,226 acres from sediment pools would result, and periodic flooding of an additional 2,900 acres would occur on retarding pool areas. A total of 12 miles of perennial and 1 mile of intermittent stream channel would be inundated. Clearing of 1,360 acres of woodlands would be necessary. The cost of this alternative would be \$15,241,000.

#### Alternative C

Land treatment as described in "A", eight large floodwater retarding structures in the uplands on tributaries to the mainstem of the Little Black River and 85 miles of multiple-purpose channel modification along the manmade ditches in the delta. An 80 percent reduction in average annual flood damages would result. The sediment pools of these structures would inundate 761 acres of agricultural and wildlife habitat land; retarding pools would periodically flood 2,035 additional acres. The reservoirs would also inundate 12 miles of perennial stream and 1

mile of intermittent stream. Clearing of 818 acres of woodlands would be necessary. Purchase of fee title and flowage easements on 1,775 acres and 2,390 acres, respectively, would be required. Cool water stream fish species (e.g., smallmouth bass, rock bass) would be largely replaced by warm water reservoir species (e.g., largemouth bass, bluegill). This alternative could be implemented under PL-566 authority at an initial cost of \$18,546,000.

#### Alternative D

This alternative would use land treatment as described in "A", 25 single-purpose floodwater retarding structures in the uplands and straightening the Little Black River to carry a 5-year frequency flow from the point that it enters the delta flood plain (Sec. 24, T23N, R4E) to the Current River. There would be a 90 percent reduction in average annual flood damages. The retarding structures would inundate 1,226 acres of agricultural and wildlife habitat land due to sediment pools; retarding pools would periodically inundate 2,900 additional acres. Approximately 18 miles of new channel would be constructed, and 24 miles of the Little Black River channel and existing fish and wildlife habitat would be destroyed. This would represent a loss of the aesthetic value of the river as well as approximately 3,840 annual recreation visits, including canoeists and stream fishermen. In addition, 12 miles of perennial stream and 1 mile of intermittent stream channel would be flooded by the retarding structures. Channel construction would require that nine bridges be either rebuilt or have extensions installed. An estimated 4.6 million cubic yards of excavation would be necessary. This alternative would create numerous ownership problems along the new channel because present land ownerships are to the center of the existing channel in many cases. This alternative could be implemented under PL-566 authority at an initial cost of approximately \$22,022,000.

#### Alternative E

This includes land treatment as in "A", 25 single-purpose floodwater retarding structures in the uplands with a diversion at Gaines Slough (Sec. 36, T23N, R4E) enlargement of ditch No. 3 along its present alignment to the State line and the junction with ditch No. 1, alignment of ditch No. 1 to the Little Black River, and straightening the Little Black River from the Current River to the junction of ditch No. 2 (just above the State line). This alternative would divert the 5-year frequency flow from the Little Black River to ditch No. 3. Channel modifications would require bottom widths ranging from 80 feet at the lower end to 40 feet at the upper end, and depths ranging from 12 to 18 feet. With this depth, the channel bottoms would be in the sand strata and would have stability problems. Clearing of 2,280 acres of woodland would be necessary. Ten bridges would need to be extended or rebuilt, and 5.3 million cubic yards of excavation would be needed. About 10 miles of the existing Little Black River and its habitat would be destroyed which would be a significant loss of aesthetic value and 1,600 annual recreation visits. In addition, some land rights problems would occur (similar to Alternative D). The initial cost of this alternative (which would be implemented under PL-566 authority) would be approximately \$23,680,000.



## Selected Plan

The alternative of 25 structures in the uplands (19 floodwater retarding and one multiple-purpose structure in Upper Little Black; and five floodwater retarding structures in Lower Little Black), a by-pass floodway approximately parallel to the Little Black River, and the rebuilding of the manmade ditches in the delta was selected because it met the objectives of the sponsors with consideration to effects on fish and wildlife resources. The Fish and Wildlife Service Reconnaissance Report on this project stated that floodwater retarding structures in the uplands, while destroying some upland game habitat, were not objectionable since they would create open areas with probably some water for watering places in the forested uplands. <sup>15/</sup> By using a diversion structure on the Little Black River to divert the part of the 2-year frequency flood flow that is in excess of its capacity, the Little Black River will continue on its present course, thus preserving approximately 24 miles of existing prime habitat for fish and wildlife.

Some factors considered in selecting ditch No. 3 as a bypass floodway were: (1) preserve the Little Black River in the delta in its present state, (2) prevent flood flows from leaving the banks which would cause deep scour channels that in time would change the course of the Little Black River, (3) maintain flows in the larger scour channels to maintain present habitat by placing pipes in the levees placed across these channels near the Little Black River.

Ditch No. 3 was selected for enlargement to carry extra floodwater since (1) it is approximately the same elevation or in some cases lower than ditch No. 1, (2) enlargement of ditch No. 3 was also required to carry the flows from lateral channels which originate in Butler County, (3) five bridges would need to be enlarged on ditch No. 3 whether or not it was selected for the floodway, and (4) five bridges would be enlarged on ditch No. 1 if it were selected. By using ditch No. 3, only five bridges on ditch No. 3 will need to be enlarged or rebuilt, as compared to 10 bridges if both ditches were enlarged.

Numerous conferences were held with the Missouri Department of Conservation to work out a plan for ditch No. 3. The proposal agreed upon involved the use of control grade and modification of the structures to hold water for fisheries. These drop structures will reduce channel grade and maintain a velocity which will meet design criteria for a stable channel. Mitigation measures; such as, sheet piling deflectors, holes dug along the side of the channel, and chutes off the drop structures to create holes, were considered. Because of the erosion created by these measures, the drop structures with water impoundments and ports for fish passage through the structures were considered more desirable.

## WORKS OF IMPROVEMENT TO BE INSTALLED

### Land Treatment Measures

The Soil and Water Conservation Districts of Butler, Ripley, and Carter Counties are conducting conservation programs with cooperators. These programs, based on the use of each acre of land within its capabilities and its treatment in accordance with its needs, are an essential part of watershed protection. The extent of needed land treatment measures applied to date represents an expenditure by landowners and operators of approximately \$1,331,400 (Table 1A).

Land treatment measures will be installed for watershed protection and flood prevention. Generally a combination of land treatment practices are required and must be tailored to fit the land, topography, use, soil properties, and management ability of the land user. To insure the orderly application and maintenance of land treatment measures, resource conservation plans will be developed on at least 65 percent of the watershed.

Treatment of cropland, which is almost entirely concentrated in the flood plain area, will consist primarily of conservation cropping systems, crop residue use, land smoothing, drainage field ditches, diversions, grade stabilization structures and grassed waterways or outlets. Approximately 7,000 acres of cropland will be adequately treated during the project period. Other land treatment measures giving partial protection will be installed that are not reflected in acres adequately treated in Table 1. The costs of planning and installing the practices are included in the table. The practices to be applied are described below:

Conservation Cropping System--This practice is defined as growing crops with needed cultural and management measures. Cropping systems include rotations that contain grasses and legumes, as well as rotations in which the desired benefits are achieved without the use of such crops. The purpose is to improve or maintain good physical conditions of the soil; protect the soil during periods when erosion usually occurs; help control weeds, insects, and diseases; and meet the need and desire of farmers for an economic return. This practice is applicable on all cropland and certain recreation and wildlife land.

Crop Residue Use--This practice is defined as using plant residue to protect cultivated fields during critical erosion periods. The purpose is to conserve moisture, increase infiltration, reduce soil loss and improve tilth. It is applicable on land where adequate crop residues are produced.

Grass Waterways or Outlets--This practice is defined as a natural or constructed waterway or outlet shaped or graded and established in vegetation suitable to safely dispose runoff from a field, diversion, terrace, or other structure. The purpose is to prevent excessive soil loss and formation of gullies. It is applicable where concentrated runoff must be disposed of at safe velocities.



Grade Stabilization Structures--This practice consists of structures to stabilize the grade or to control head-cutting in natural or artificial channels. It does not include structures used in drainage and irrigation systems primarily for water control. The purpose is to prevent the formation or advance of gullies and reduce environmental and pollution hazards. These structures apply where the concentration and flow velocity of water are such that structures are required to stabilize the grade in channels or to control gully erosion. Special attention will be given to maintaining or improving habitat for fish and wildlife where applicable.

Diversion--This practice is sometimes referred to as a diversion terrace. It is a channel with a supporting ridge on the lower side constructed across the slope. The purpose is to divert water from areas, where it is in excess, to sites where it can be used or disposed of safely. It is used where: (1) Runoff from higher lying areas is damaging cropland, pastureland, farmsteads, or conservation practices; such as, terraces or strip cropping; (2) Surface and shallow subsurface flow is damaging sloping upland; (3) Runoff is available for diversion and use on nearby sites; and (4) A pollution abatement system or control of erosion and runoff from urban or developing areas and construction sites are needed.

Diversions will not be substituted for terraces on land requiring terraces for erosion control. Usually they are not constructed below high sediment producing areas unless land treatment practices or structural measures designed to prevent damaging accumulation of sediment in the channels are installed concurrently or before the diversion.

Drainage Field Ditches--This practice is defined as a graded ditch to collect excess water in a field. This does not include drainage main or lateral or grassed waterway or outlet. The purpose is to drain surface depressions; collect or intercept excess surface water, such as sheet flow from natural and graded land surfaces or channel flow from furrows for removal to an outlet; and collect or intercept excess subsurface water for removal to an outlet.

It is used on flat lands that have soils of low permeability or shallowness over barriers such as rock or clay which hold or prevent ready percolation of water to a deep stratum; areas that have insufficient land slope for ready movement of excess runoff; and areas that require removal of excess irrigation water or control of the ground water table. It is necessary that this practice have adequate outlets available for disposal of drainage water by gravity flow or pumping.

Land Smoothing--This practice is defined as removing irregularities on the land surface by use of special equipment. Ordinarily, this does not require a complete grid survey. It includes operations ordinarily classed as rough grading. This does not include the "floating" done as a regular maintenance practice on irrigated land



or the "planing" done as the final step in irrigation land leveling or drainage land grading. The purpose is to improve surface drainage, provide for more effective use of precipitation, obtain uniform planting depths, provide for more uniform cultivation, improve equipment operation and efficiency, improve terrace alignment, and facilitate contour cultivation. This practice is applicable on lands where depressions, mounds, old terraces, turn rows, and other surface irregularities interfere with the application of needed soil and water conservation and management practices. It is limited to areas having adequate soil depths.

Pastureland treatment will include brush and weed control pasture and hayland planting, pasture and hayland management, ponds for livestock water, and an adequate fertility program. Pasture and hayland management will be used to bring forage production for each season in balance with livestock needs. Approximately 8,000 acres of pastureland will be adequately treated during the project period. Some of these practices will be applied on additional pastureland. The practices to be applied are described as follows:

Pastureland and Hayland Management--This practice is defined as proper treatment and use of pastureland or hayland. The purpose is to prolong the life of desirable forage species; maintain or improve the quality and quantity of forage; protect the soil; and reduce water loss.

Pastureland and Hayland Planting--This practice is establishing and reestablishing long-term stands of adapted species of perennial, biennial, or reseeding forage plants. It includes pasture and hayland renovation but does not include a grassed waterway or outlet on cropland. It reduces erosion, produces high quality forage, and adjusts land use. It is applicable on existing pasture and hayland or on land that is converted from other uses.

Ponds--This is defined as a water impoundment made by constructing a dam or embankment or by excavating a pit or dugout. Ponds are constructed to provide water for livestock, fish and wildlife, recreation, fire control, crop and orchard spraying, and other related uses. In this project the ponds constructed will be located in predominantly rural or agricultural areas where failure of the structures would not result in the loss of lives; damage to homes, commercial or industrial buildings, main highways, or railroads; or interruption of the use of service of public utilities. Generally, the distance between the lowest point of the natural ground along the centerline of the dam and the crest of the emergency spillway will not exceed 20 feet. Technical assistance by Soil Conservation Service personnel will be furnished to landowners to assure that: (1) Site conditions, drainage area, topography, or soil of the site will permit storage of water at a depth and volume that will insure a dependable water supply; (2) The foundation for the dam is adequate; and (3) In the reservoir area the soil is impervious enough to prevent excessive seepage losses or is a type that sealing is practicable.

Forest land management plans will be prepared for approximately 170 landowners, involving 32,720 acres, to provide for the proper installation and maintenance of forestry measures on private land.

A land treatment program has been developed for private lands from a statement of land treatment needs prepared by the Division of Forestry of the Missouri Department of Conservation in cooperation with the U.S. Forest Service. Needs were determined by a field survey of the watershed. The following program is planned for installation:

Tree Planting (150 acres).--Reforestation of appropriate open lands in private ownership is necessary to adjust planned use with capability and to reduce runoff and erosion by developing a protective cover and absorbent forest floor of litter and humus.

Hydrologic Cultural Operations (9,250 acres).--These silvicultural operations are aimed at improving hydrologic conditions of private forest lands by manipulation of stand composition to create conditions favorable for the maximum production and protection of litter, humus, and forest cover. They include thinnings, weedings, improvement, salvage, intermediate harvest and harvest cuttings, and supplemental plantings.

Fire Control Intensification (90,277 acres).--Adequate fire protection is necessary to derive maximum benefits from other watershed works of improvement. In order to meet and provide for minimum watershed requirements, it will be necessary to purchase additional fire suppression equipment for use on the watershed. This equipment includes a crawler tractor, fire plow, truck, radios, and handtools. This set of equipment will serve both the Upper and Lower Little Black Projects.

During development of resource conservation plans landowners will be encouraged to plan and apply forage, forestry, and cropland management practices that are important in maintaining or developing favorable wildlife conditions. Forest cutting patterns, differing age classes in forest stands, native grass establishment, crop residue use, and crop rotation are important considerations that can benefit wildlife. Protecting existing stands of fruit-producing shrubs and making new plantings of these on eroding areas, gullies, and steep banks will benefit wildlife. Native warm season grasses and legumes established around floodwater retarding pools will reduce wind erosion, sediment accumulation, and increase wildlife values. Some establishment of tall grasses and trees around farmsteads and on sandy soils will provide windbreaks and beautify landscapes.

Resource conservation plans on some individual farms which will be developed for private and income-producing recreation will include recreation practices. Recreation area stabilization, recreation area improvement, recreation trails and walkways, and ponds are included in the practices to be applied.



A work plan has been developed for completing and publishing a soil survey in Butler and Ripley Counties. There are about 211,000 acres of the Little Black Watersheds in the soil survey area. Approximately 109,720 acres is in Upper Little Black. It is estimated that 1 man-year of technical assistance will be needed to complete that portion of the survey. Farmers cooperating with the soil and water conservation districts will use this information in developing resource conservation plans that will help achieve proper land use and meet the conservation needs of the land.

#### National Forest System Lands

The existing program of the Forest Service on National Forest System Lands, which includes fire control, silvicultural treatments, and other multiple-use resource development, will be continued.

The land treatment programs for the National Forests of Missouri provide for:

1. Conducting a land inventory of 2,676 acres of forest land in National Forest ownership.
2. Performing silvicultural operations on 890 acres to improve stand composition and wildlife habitat.

Application and continued maintenance of land treatment measures is important; without them, installation of the other work plan features would not produce the expected benefits. The amounts and estimated costs of land treatment to be applied during the project period are shown in Table 1.

#### Structural Measures

The structural measures will consist of the following:

1. Nineteen floodwater retarding structures - single-purpose.
2. One multiple-purpose structure - floodwater retarding and recreation and associated recreation development.

#### Reservoir-Type Structures

A total of 19 floodwater retarding structures and one multiple-purpose structure (floodwater and recreation) is planned to be installed. (See Typical Earth Dam With Pipe Drop Inlet - Figure 1.) They will range in height from 26 to 82 feet and will control a total drainage area of 145.69 square miles, representing approximately 74 percent of the watershed area. Table 3 summarizes structural data on these sites.

The foundations and abutments on all structure sites are gravelly and range from clayey silts to silty clays. The generally dense foundations range from 5 to over 50 feet in depth. Foundation drains are planned on all structures to control seepage in the moderately permeable foundation soils.



A positive cutoff through the permeable foundation materials to bedrock is planned for multiple-purpose structure B-9. This cutoff will extend up the slopes to the permanent pool elevation.

The principal spillways will be reinforced concrete pipes or box culverts with open top risers on yielding foundations. Structures A-3, B-9, C-7, and D-2 will have box culvert conduits with S.A.F. outlets as energy dissipaters and two stage inlets. These four structures will have two low-stage inlets at the same elevations--one will be an ungated port and the other a gated port. (See Detail of Gated Riser, Figure No. 2.) The two low-stage inlets are planned to control a 5-year, 24-hour storm runoff. This controlled runoff will reduce the peak discharge of the design storm at the diversion structure and floodway in the Lower Little Black Watershed Project.

The 19 floodwater retarding structures will have vegetative emergency spillways. They will control a total drainage area of 120.12 square miles. The emergency spillway will operate as follows:

1. Less than 1 percent chance (less than once in 100 years) - Site A-2, A-3, A-7, B-1, B-2, B-3, B-4, C-7, and D-2.
2. Four percent chance (once in 25 years) - Sites A-5, A-13, D-1, D-3, D-4, D-5, D-7, D-8, D-9, and D-12.

These structures will contain a total floodwater detention capacity of 37,576 acre feet. The temporary flood storage pools will contain from 2.25 to 11.08 inches of runoff from the contributing areas.

Multiple-purpose structure B-9 will have a rock emergency spillway which will operate on less than 1 percent chance frequency (once in 100 years). The additional drainage area controlled is 25.57 square miles. Total floodwater detention capacity is 11,586 acre feet which includes 4,293 acre feet between the low and high stage flood inlets. The temporary flood storage pool will contain 8.50 inches of runoff from the contributing area.

All embankments are to be compacted earthfills. The borrow areas will be located within the reservoir area and the emergency spillway except in the B-9 site. The borrow for B-9 will be from areas above the recreation pool. The excavation from the emergency spillways will generally be clays from the residuum. The borrow from the alluvium will be sandy silts, sands, and gravels.

The total land rights required by perpetual easements for these 19 single-purpose floodwater retarding structures is 2,599 acres. Clearing on all sites will be limited to the main area of the sediment pools or recreation pool and that area required for construction of the earthfill and emergency spillway. Narrow reservoir areas within channel banks will not be cleared. Root wads and brush piles from clearing will be stacked and left in the sediment pools for fishery habitat. The areas required

for earthfills and emergency spillways is approximately 126 acres, and the land use is 9 percent cropland, 83 percent forest land, 7 percent pastureland, and 1 percent other uses. The area required for the sediment pools in the 19 structures is 755 acres. Land use on this area is 25 percent cropland, 3 percent pastureland, and 72 percent forest land. Area required by the flood pools is 1,703 acres. Land use on this area is 8 percent cropland, 91 percent forest land, and 1 percent pastureland. Approximately 660 acres will require clearing.

The total land rights to be acquired for multiple-purpose structure B-9 and the recreational facilities is 1,465 acres. The area to be acquired in fee simple title is 1,311 acres. The remaining land rights, 154 acres, will be acquired by perpetual easements.

Area within the permanent recreation pool is 298 acres. Land use in this area is 25 percent cropland, 3 percent pastureland and 72 percent forest land. The area within the temporary flood pool is 334 acres. Land use in this area is 8 percent cropland, 1 percent pastureland, and 91 percent forest land. The 334 acres include the area between the elevation of the recreation pool and 2 feet above the crest of the emergency spillway. The land area required for the dam and emergency spillway is 14 acres. Land use of this area is 9 percent cropland, 83 percent forest land, 7 percent pastureland, and 1 percent other. Installation of structure B-9 and associated recreation facilities will require clearing on 227 acres.

Land area to be acquired for the recreation facilities is 819 acres. The land use is primarily forest land and no changed land is anticipated except at isolated areas where facilities will be built.

All structures were designed for a 100-year life. The principal spillway inlets will be installed at the elevation of the 100-year sediment accumulation, unless the sponsors request the risers to be ported at some lower elevation.

All structures were designed with a draw-down to drain the impoundment, as needed. This drain will permit draining of the construction site and borrow areas during construction and lowering the permanent pool for maintenance and repair. Principal spillway inlets will be modified to provide for cold water release in structures A-2, A-3, A-7, B-1, B-2, B-9, C-7, D-2, and D-4.

Structures A-3, B-9, C-7, and D-2 on perennial-flow streams with uncontrolled drainage areas of 15.39, 25.57, 27.41, and 11.29 square miles, respectively, will have two water release ports installed in the principal spillway riser. These will release water from the sediment pool to insure more normal summer stream flows during periods of drought. One release will be located near the bottom of the riser, and the other approximately 5 feet below the sediment pool elevation. The combined capacity of the two ports will be 0.02 c.s.m. The release flows will be approximately 0.8, 0.9, 0.5, and 0.2 c.f.s., respectively. (See Figure 2.)



Existing facilities affected by structures are roads, bridges, powerlines, a pipeline, buildings, and a cemetery. An easement for temporary flooding of county roads in the flood pools of structure A-3, B-9, and B-1 will be required. State Highway 21 will be modified or rerouted because of flooding from structure C-7, and an easement will be obtained from the State Highway Department for this condition. Powerlines will be modified, removed, or rerouted in sites A-2 and A-3. Easements will be obtained for a pipeline in the flood pool of B-9.

Structure sites A-3 and C-7 will involve the removal of buildings. Site C-7 will require removal of one dwelling and related out-buildings in the flood pool. One family living in a rental unit at site C-7 will be displaced.

At site C-7 an old family cemetery plot is also located in the upper elevation of the flood pool. This plot contains approximately 25 graves with the latest being 1893. This plot will be temporarily inundated at flood stage. A levee or a mound is planned to prevent flooding of this plot. The elevation of the lowest grave is 478.4 feet above mean sea level, and crest of the spillway is 497.1. The protection is planned to elevation 498.1 feet or 19.7 feet above the lowest grave.

Sediment pools in all the single-purpose floodwater retarding structures will have potential for limited recreational use by the owners, operators, and their friends by permission. Access by the general public will be prohibited unless or until adequate sanitary facilities are provided which meet state and local health requirements. At site A-3 a present landowner has indicated their intent to provide general public access on a fee basis to the sediment pool under their control. One owner on Site C-7 will provide free public access to that part of sediment pool under their control.

#### Public Recreation

The recreational development at multiple-purpose structure B-9 consists of the reservoir and the stream immediately below the structure from the dam to Highway K and the land adjacent to the reservoir and stream for recreational facilities. Public access to the reservoir and stream below is available around the entire water area.

The design capacity in activity occasions for the following major activities are:

Fishing, Boating and Canoeing	78
Swimming	750
Camping	848
Picnicking	555

Other recreational opportunities available will be hiking, scenic overlooks, nature study, and playfields. A recreational participant usually seeks more than one activity in a day. The above activities are designed to accommodate 1,763 persons in a peak day.



## Works of Improvement to be Installed

The land and water areas available for recreation and recreation facilities to be installed are shown in the Public Recreation Development Plan (Figure 3). Land rights for multiple-purpose structure B-9 will include 1,311 acres for recreation facilities and structure B-9; flood easements will be acquired on an additional 154 acres. The 1,311 acres will be purchased in fee simple title and will include 492 acres for the sediment pool, recreation pool, flood pool, dam, and emergency spillway. The remaining 819 acres will be for recreation facilities. A total of 298 acres of water and 1,013 acres of land will be available for recreational use.

Recreation facilities will be installed (with PL-566 assistance) during project installation. The facilities to be installed will be of high quality in keeping with standards for Missouri State Parks. These facilities are itemized in Table 2B and include access roads, parking areas, camping areas, hiking trails, nature interpretation area, beach swimming, bank fishing, boating, picnicking overlook areas, and canoe access areas. Items included in these areas are shelters; restrooms; bath houses; sanitary and trash disposal facilities; playground equipment; play fields; and water, sewer and electrical systems. All facilities around the reservoir except the swimming beach and boat launch will be installed above the flood pool elevation. The facilities to be located between the dam and Highway K except for day use facilities; such as picnic tables and playgrounds, will be installed above the 100-year flood line with the structures installed.

Two dwellings and associated utilities will be built in the headquarters area of the recreation development as a nonproject feature by the Missouri Department of Natural Resources, Division of Parks and Recreation.

Installation, operation, and maintenance of all planned recreational facilities will comply with local and state health requirements. All facilities in which federal cost sharing is involved will be designed and constructed to assure accessibility and usability by physically handicapped people in accordance with PL-90-480. The American Standard Specifications for making buildings and facilities accessible to, and usable by, the physically handicapped will be used as guidelines.

### Environmental Considerations

Construction operations will be performed in a manner that will provide the greatest protection to environmental values. This will include minimizing water pollution and protecting fish and wildlife habitat, forest resources, and the natural beauty of the area. Weather conditions will normally permit construction to proceed without a winter shutdown. This will allow a more rapid completion of the construction and a more timely seeding of the disturbed areas. A construction operation plan for minimizing the effects of construction on the environment will be a part of each contract.

Works of Improvement  
to be Installed

Some items that will receive careful attention in planning and constructing are: (1) Size and duration of exposure of denuded areas will be minimized, (2) Runoff from the construction site will be controlled to prevent erosion, (3) Where needed, sediment traps and debris basins will be installed, (4) Temporary bridges or culverts will be used where fording stream is objectionable, (5) Diversion above all cut slopes will be required to prevent concentration of runoff across the exposed areas, (6) The embankment surface will be maintained in a manner that will minimize stream channel pollution should the embankment overtop, (7) Soil will be protected by use of vegetation, (8) Segments of work will be completed and protected as rapidly as possible consistent with construction schedules, (9) Dust will be kept within tolerable limits, and (10) Burning will comply with regulations of Missouri.

Archeological, Historic, and Scientific

The Arkansas Archeological Survey and the Missouri Archeological Survey have provided the location and importance of prehistoric remains in the area. Project measures will not affect any properties listed in the "National Register of Historic Places." It is anticipated that through the cooperation existing between local groups and concerned state and federal agencies, significant archeological remains can be protected. Information which may become available during construction could also add to the prehistoric knowledge of the area. If archeological sites are found during construction the Missouri Archeological Survey and National Park Service will be notified.

## EXPLANATION OF INSTALLATION COSTS

The total cost of installing land treatment measures is \$750,100. This includes \$224,700 for technical assistance, \$7,900 for fire suppression equipment, and \$517,500 for application of individual measures. A total of \$121,600 of PL-566 funds will be used for accelerated treatment assistance; \$60,000 of this will be provided by the Soil Conservation Service and \$61,600 will be provided by the Forest Service. Technical assistance for the ongoing program is estimated to cost \$103,100, of which \$45,000 will be provided by the Soil Conservation Service under the PL-46 program. The estimated cost of technical assistance for installing cooperative forest management program is \$58,100. The \$58,100 consists of \$11,600 from the Missouri Department of Conservation, Division of Forestry; and \$46,500 from the Forest Service under the going cooperative forest management program. The proportional project share in the cost of additional fire suppression equipment will be provided by PL-566 in the amount of \$4,500 and \$3,400 by the Missouri Department of Conservation, Division of Forestry.

Costs of the installation of the forest land treatment measures are based on current costs of supervision, labor, equipment, and materials needed to perform the particular measures on national forest and private land. Fire suppression equipment costs are also based on current costs of standard equipment. Costs of technical assistance for the installation of the forest land treatment measures on private land are based on actual expenditures and accomplishments by the Missouri Department of Conservation. An analysis of the costs against the accomplishments was made of each measure to determine unit costs for technical assistance.

The total estimated cost of installing structural measures is \$11,284,085, of which \$1,015,293 will be borne by other funds and \$10,268,792 by PL-566 funds. The installation costs for structural measures include construction, engineering, relocation payments, project administration, and land rights.

The construction cost of the single-purpose floodwater retarding structures (\$5,852,700) will be borne by PL-566 funds. The construction cost (\$1,838,000) of the multipurpose structure B-9 will be shared 92.6 percent by PL-566 funds and 7.4 percent by other funds. The construction cost (\$671,820) of the recreation facilities will be shared 50 percent by PL-566 funds and 50 percent by other funds. The construction cost (\$56,500) for two residences and associated utilities will be borne by other funds as a non-project cost.

The "Use of Facilities" method was used to allocate joint costs to each purpose in this structure. Allocation to purpose is as follows:

Purpose	Storage (acre feet)	Allocation (percent)
Flood Prevention	12,834	85.3
Recreation	2,213	14.7
Total	15,047	100.0



## Explanation of Installation Costs

The total construction cost of \$8,362,520 consists of a current contract cost estimate based on previous construction costs, plus a 12 percent contingency allowance for unexpected costs. The construction cost will be shared \$7,891,517 by PL-566 funds and \$471,003 other funds.

Estimated engineering costs are \$836,580. The PL-566 share will be \$769,400 for services of engineers, geologists, and technicians for surveys, investigations, designs, and preparation of plans and specifications for all reservoir structures. The cost for engineering services (\$67,180) for recreational facilities will be shared by 50 percent PL-566 and 50 percent other funds. Engineering and architectural services to develop plans and specifications for recreation facilities will be secured from a consulting engineering firm. Such engineering and architectural services are eligible for PL-566 cost sharing. The PL-566 cost sharing will not exceed 50 percent of the payments made for engineering and architectural services costs for facilities.

The total estimated cost for relocation payments is \$20,000. This cost will be shared, based on the ratio of PL-566 funds and other funds to the total project costs. The relocation costs will be shared 86.3 percent, or \$17,260, by PL-566 funds and 13.7 percent, or \$2,740, by other funds.

The estimated cost of the land rights for the 19 single-purpose floodwater retarding structures is \$270,685 which will be borne by other funds without cost share from PL-566 funds. This includes \$2,000 for moving a powerline at structures A-2 and A-3; \$21,866 for a cemetery levee or mound at structure C-7; and \$15,000 for rerouting or modification of Highway 21 at structure C-7.

The land rights costs for multiple-purpose structure B-9 are estimated to be \$373,500. This includes \$19,250 for 154 acres of flowage easements which will be borne by other funds and \$354,250 for appraising and acquiring 1,311 acres of land in fee simple which will be cost shared equally by PL-566 and other funds. The land acquisition costs include the cost of land appraisal, \$6,500 for a berm over a pipeline, and \$20,000 for moving a farmstead and camp buildings.

The total cost of land rights in Upper Little Black Watershed is \$644,185. Included in the \$644,185 is \$6,440 for legal fees, surveys, and easement costs which will be borne by local funds. The \$6,440 includes \$4,250 for 19 single-purpose floodwater retarding structures and \$2,190 for multipurpose structure B-9.

The sponsors and the Soil Conservation Service will each bear their own project administration costs. Project administration costs (\$1,379,900) to be borne by PL-566 funds include review of plans prepared by others, government representatives, construction surveys, construction inspection services, and related costs.

## Explanation of Installation Costs

Other funds will provide project administration costs (\$40,900) for administration of contracts, such construction inspections that the sponsoring local organizations desire to perform, local administrative costs, and relocation advisory assistance services (\$1,000). The relocation advisory assistance services will be borne by other funds without PL-566 cost sharing. They will be provided by Little Black Watershed Subdistrict and the Missouri Department of Natural Resources, Division of Parks and Recreation. These services will include:

1. Determining the need, if any of displaced persons for relocation assistance.
2. Providing current and continuing information on the availability, prices, and rentals of decent, safe, and sanitary sale and rental housing and of comparable commercial properties and locations for displaced businesses and farm operations.
3. Assuring that, within a reasonable period of time prior to displacement, replacement dwellings will be available.
4. Assisting persons displaced from their farm operations in obtaining and becoming established in a suitable replacement location.
5. Supplying information concerning housing programs, disaster loan programs, and other federal or state programs offering assistance to displaced persons.
6. Providing other advisory services to displaced persons in order to minimize hardships to such persons in adjusting to relocation.
7. Advising displaced persons that they should notify the displacing agency before they move.
8. Prior to initiation of acquisition, provide persons from whom it is planned to acquire land a brochure or pamphlet outlining the benefits to which they may be entitled.

The estimated cost of providing these services in this project is \$1,000.

In addition to the specific services defined as relocation assistance advisory services, the sponsors and the Soil Conservation Service will be involved in administrative functions associated with making relocation payments. These are also included in project administration costs. The Missouri Department of Natural Resources, Division of Parks and Recreation and the Little Black Watershed Subdistrict will bear, without PL-566 cost sharing, the costs they incur in serving notices of displacement, providing appropriate application forms, assisting in filing applications, hearings, resolving grievances, and making relocation payments. The Soil Conservation Service will bear the costs they incur and will assist the subdistrict in providing these services.

## Explanation of Installation Costs

The total costs of \$12,034,185 for all project measures includes \$10,394,892 from PL-566 funds and \$1,639,293 from other funds.

The estimated schedule of obligations for the 12-year installation period covering installation of both land treatment and structural measures is as follows:

### SCHEDULE OF OBLIGATIONS

Upper Little Black Watershed, Missouri

(Dollars)

Year	Measures	PL-566 Funds	Other Funds	Total
1	Land Treatment	8,100	38,000	46,100
	Structural Measures	19,300	7,400	26,700
2	Land Treatment	11,000	55,000	66,000
	Structural Measures	264,000	23,500	287,500
3	Land Treatment	11,000	55,000	66,000
	Structural Measures	826,500	42,500	869,000
4	Land Treatment	11,000	55,000	66,000
	Structural Measures	1,195,300	10,500	1,205,800
5	Land Treatment	12,000	60,000	72,000
	Structural Measures	422,400	79,400	501,800
6	Land Treatment	12,000	60,000	72,000
	Structural Measures	1,220,100	26,900	1,247,000
7	Land Treatment	12,000	60,000	72,000
	Structural Measures	723,600	35,400	759,000
8	Land Treatment	11,000	55,000	66,000
	Structural Measures	887,000	15,500	902,500
9	Land Treatment	11,000	55,000	66,000
	Structural Measures	994,500	52,900	1,047,400
10	Land Treatment	11,000	55,000	66,000
	Structural Measures	1,295,700	216,700	1,512,400
11	Land Treatment	8,000	38,000	46,000
	Structural Measures	1,984,400	168,700	2,153,100
12	Land Treatment	8,000	38,000	46,000
	Structural Measures	435,992	335,893	771,885
Total Land Treatment		126,100	624,000	750,100
Total Structural Measures		10,268,792	1,015,293	11,284,085
GRAND TOTAL		10,394,892	1,639,293	12,034,185



## EFFECTS OF WORKS OF IMPROVEMENT

The combined effects of the Upper and Lower Little Black Watershed Projects will have a major impact on this rural area. Damage from flooding will be significantly reduced. The planned improvements will increase farm profits, provide agricultural and nonagricultural jobs, stabilize incomes, and improve living conditions in the watershed. These effects, along with other beneficial and adverse effects, are discussed in this section.

### Flood Prevention, Erosion, and Sediment

Land treatment measures installed during the project period will significantly improve hydrologic conditions on much of the watershed. The land treatment measures applied during the project period will adequately treat the following land by land use:

<u>Land Uses</u>	<u>Adequately Treated Acres</u>
Cropland	7,000
Pastureland	8,000
Forest Land	43,010

Approximately the same number of acres will have some practices applied that will improve their present condition but would still need additional measures for adequate protection.

Land treatment measures on pastureland will increase livestock forage production and create a better balance between needed and used livestock forage. This will make livestock operations more stable, thus having a beneficial economic impact on rural land residents engaged in livestock farming. These measures will result in a decrease of competing woody vegetation and weeds which will reduce the value of the area for production of wildlife food and cover plants. Installation of ponds will provide more water for livestock, wildlife, and fish habitat, and water quality will be improved by the reduction of sediment.

The forest land treatment program will develop a protective and absorbent cover of litter and humus to reduce runoff and erosion, as well as improve other hydrologic conditions. Proper management and added fire protection will increase the productivity of forest land.

Land treatment on cropland will reduce the rate of runoff, erosion, and sedimentation. Cropland treatment which is concentrated in the flood plain will result in less flooding of fields and improve field drainage. Where grassed waterways replace woody and/or weedy vegetation, they may eliminate a desirable habitat for wildlife.

Land treatment to be completed during the project installation period will reduce watershed sheet erosion on the upland as follows:

# Effects of Works of Improvement

Upland Land Use	Without Project	With Project
	Tons/Acre/Year	Tons/Acre/Year
Cropland	7.2	4.0
Idle Land	4.0	a/
Pastureland	3.0	3.0
Forest Land	4.2	3.0
Other	4.0	4.0
Average Sheet Erosion	4.3	3.1

a/ This land use is expected to change to pastureland or forest land.

Sheet erosion in the upland will be decreased due to conversion of cropland to pasture and forest land and better management of all land uses. Stream-bank erosion will be reduced from 1.0 ton/acre/year to 0.1 ton/acre/year. Roadside and other losses will be reduced from 1.4 tons/acre/year to 0.3 ton/acre/year.

The Upper Little Black Watershed Project is closely related to the Lower Little Black Watershed Project. Measures identified in both projects must be installed to achieve the effects described in this plan. Dams in the Upper and Lower Little Black Projects will control 72 percent of the total upland area, or 52 percent of the combined watershed areas.

Area benefited, the percent reduction in damages, and the average degree of protection that will be obtained from the combined project of land treatment and floodwater retarding structures in this watershed are listed as follows:

Reach	Area Benefited Acres	Percent Reduction in Damages	Average Degree Protection Recurrence Interval (Year)
Ia	1,495	77	2
I	2,267	96	3
II	780	85	2
IIIa	716	75	1
III	715	97	8
IV	412	92	4
V	1,326	83	2
TOTAL <u>b/</u>	7,711	85	

b/ Seventy-four percent of watershed controlled by structures.

## Effects of Works of Improvement

The combined projects of Upper and Lower Little Black will have a major effect on the flood plain in the Lower Little Black Watershed. Flood peaks, area inundated, and duration of flooding will be reduced substantially after installation of the projects. The combined projects consisting of structures and channel will generally provide a 2-year level of protection in the vicinity of the improved channel. Frequent flooding will continue along the Little Black River in reaches VI, VIII, and IX because of the present restriction in the river channel. The area benefited, percent reduction in damages, and the average degree of protection that will be obtained from the combined Upper and Lower Little Black Projects from land treatment, floodwater retarding structures, and channel work are listed as follows:

Reach	Area Benefited Acres	Percent Reduction in Damages	Average Degree Protection Recurrence Interval (Years)
VIa (upland)a/	158	21	Less than 1
VI	16,479	90	3
VII (upland)b/	1,465	85	3
VIII	7,151	83	2
IX	1,800	88	3
X	5,490	75	2
TOTAL	32,543	84	

a/ Fifty-two percent of both Upper and Lower Little Black Watersheds will be controlled by structures.

b/ These reaches are protected from measures located only in the Lower Little Black Plan.

Peak flows and depth of flow will be reduced at the lower end of reaches I and V by the project as follows:

Reach	Recurrence Interval	Percent Reduction in Peak Discharge	Reduction in Stage (feet)
I	100-year	73	4.8
	5-year	65	4.0
	2-year	60	2.6
V	100-year	65	1.9
	5-year	62	1.3
	2-year	61	0.9



Peak flows and depth of flow in the Lower Little Black Project will be reduced at the lower end of reaches VII and VIII by the combined projects as follows:

Reach	Recurrence Interval	Reduction In Peak Discharges	Reduction In Stage
		(percent)	(feet)
VII	100-year	78	3.9
	5-year	70	2.2
	2-year	64	1.9
VIII	100-year	25	3.5
	5-year	18	5.9
	2-year	13	4.8

Area flooded by frequency will be reduced in the watershed and outside the watershed in the Lower Little Black project as follows:

Frequency	Within Watershed Acres		Lower Little Black Watershed Acres	
	Without Project	With Project	Without Project	With Project
100-year	7,711	2,968	32,543	24,107
5-year	5,111	1,020	25,674	7,367
2-year	2,964	464	18,224	760

The 100-year flow will be reduced by 65 percent and the 2-year flow will be reduced 61 percent at the outlet of the watershed. Much of the remaining flooded area represents flows which will be reduced in depth and duration and will result in only minor crop damage.

The gates incorporated into the design of structures A-3, B-9, C-7, and D-2 will assist in reducing discharges from storms of 5-year frequency magnitude or smaller. When these gates are closed, peak discharges for a 2-year frequency storm will be reduced by approximately 850 c.f.s. at the lower end of reach V, compared to when these gates are open.

In addition to the effects in this watershed, the Upper and Lower Little Black Projects will also reduce flood losses downstream. The Comprehensive Basin Study on the White River Basin, Arkansas and Missouri, was published by the White River Coordination Committee in June 1968. This study identifies reduction in damages accruing to the Little Black Projects. These benefits consist of reductions in damages to crops and pastures, fences, roads, bridges, livestock, farm buildings, and indirect losses. They will accrue in the Black Rock, Lockheart Ferry, Newport, Augusta, and Success reaches included in the White River Study.

Flood plain area inside the watershed flooded by a storm similar to the 1961 flood would be reduced 83 percent from approximately 3,000 acres to 500 acres with the installation of this project. The area flooded in Lower Little Black by a storm of the same magnitude as the 1961 flood, will be reduced from approximately 18,224 acres to 760 acres, a reduction of 96 percent. The area flooded in this watershed by a storm similar to that of 1964 would be reduced from 7,500 to 2,500 acres. The combined projects would reduce flooding from 31,000 to 20,000 acres in Lower Little Black Watershed for a storm of the same magnitude.

Flood plain lands are used for production of grain crops and hay. Corn, soybeans, and hay are the most important crops grown. Crop yields will increase as a result of reduction of floodwater. More intensive land use will result through an increased use of fertilizer, higher seed quality, and improved cultivation practices. Restoration of former production or changed land use is not expected to occur in the bottom land area. Economic justification of the project does not include benefits derived from increased production of surplus crops on new lands.

The flood damage to highways, bridges, fences, loss of farm equipment and livestock, and debris cleanup will be reduced as a result of installation of the project.

Flood plain use with the project installed will be limited primarily to agriculture. Farmsteads and other permanent improvements should not be installed in previously flooded areas as major storms will still inundate these areas with the projects installed.

Construction of the 19 planned floodwater retarding structures will require 881 acres for dams, emergency spillways and sediment pools. Multiple-purpose structure B-9 will require 312 acres. Present land use is 874 acres of forest land, 277 acres of cropland, and 42 acres of pastureland. Approximately 8 miles of perennial stream and 3.5 miles of intermittent stream will be permanently inundated by recreation and sediment pools by the 20 structures. The structures are dispersed throughout or adjacent to the Clarksville, Captina, and Wilderness soil series. Eighty-three percent of this association is oak-hickory forest type. Pool sizes range from 11 to 298 acres, averaging 53 acres. The structures are all more than 1 mile apart.

Installation of land treatment measures, retarding structures, and multipurpose structure will reduce the amount of sediment and other pollutants flowing into the Little Black River. Over a 100-year period, reservoirs in Upper Little Black are designed to trap 7,780 acre feet of sediment. These reservoirs control 74 percent of the upland area and will trap an estimated 95 percent of the sediment carried into them. The dams will trap an estimated 111,785 tons of sediment annually. Sedimentation of drainage and highway ditches will be reduced. Average annual sediment discharged at the mouth of the watershed will be reduced from 96,907 to 41,360 tons, a reduction of 49 percent.



The dams planned in the Lower Little Black Watershed Project are designed to trap 2,940 acre feet of sediment. The combined sediment storage in both plans is 10,720 acre feet. The dams in both projects will trap an estimated 138,106 tons of sediment annually. Sediment from both Upper and Lower Little Black Watersheds will be reduced from 172,955 to 79,730 tons, a reduction of 54 percent.

Installation of the project will reduce damages on approximately 7,711 acres of flood plain. The structural measures will benefit an estimated 125 agricultural landowners.

Average annual sediment damage will be reduced 85 percent from \$32,952 to \$4,800 for a reduction of \$28,152. This includes \$26,639 for overbank deposition and \$1,513 for swamping.

Flood plain scour which affects 31 percent of the flood plain or 2,390 acres will be reduced by 82 percent. Average annual scour damage will be reduced from \$33,040 to \$5,898 for a reduction of \$27,142.

The project will result in a reduction of \$79,755 agricultural damages, or 85 percent. Nonagricultural damages will be reduced \$4,788 or 86 percent.

Water quality will improve due to the application of land treatment measures and the shift to more grass and forest land in the uplands. The installation of retarding structures will have considerable effect on the amount of sediment flowing into the Little Black River and other channels. Affects on other pollutants of the stream will be reduced in approximately the proportion they are associated with the sediment fraction. Because no major pollution problems presently exist, little effect is anticipated on existing or possible pollutants. The relatively high phosphate concentrations found may become more associated with trapped sediment and thus be reduced, but this is not expected to substantially reduce phosphate concentrations below structures. Evaporation will increase due to the construction of sediment pools in the area.

With the project, the sediment pools of the floodwater retarding reservoirs will provide 755 acres of potential fishing water. The 19 pools will range in size from 11 to 136 surface acres. The average depth will be 8 feet which will be sufficient to support fish. Inflow to structure sites is expected to be greater than evaporation and seepage losses as the ratio of drainage area to surface area of the sediment pools will range from 154:1 to 46:1.

The sediment pools of the floodwater retarding structures will provide opportunities for developing facilities for fishing and hunting. Two of these sites are expected to be open for recreational uses. One landowner at site A-3 will have 110 acres of water and 38 acres of surrounding land available for recreational opportunities. Fifty-nine acres of water at site C-7 is owned by Missouri Department of Conservation as a part of public hunting land adjoining this site. These two sites will furnish an estimated 17,000 recreation days annually.



The planned project measures will greatly reduce the threat of injury and loss of life to people living and traveling in the flood plain by reducing the depth and velocities of floodwater flows. There will be interrupted traffic where flood pools inundate some county roads. In flood plain areas, however, interruption of travel, mail deliveries, and work delays will be much less a problem after the installation of the project than under present conditions without the project.

The hazards of health caused by contamination of domestic wells and pollution will be reduced. The hazard caused by sediment pollution of floodwaters will be reduced due to the trapping effect of the floodwater retarding reservoirs.

#### Agricultural Water Management

The combined project of land treatment and structural measures will provide benefits to 7,711 acres of flood plain which includes approximately 125 operating units. Crop damage will be eliminated in most areas from floods up to about the 2-year frequency level. Landowners and operators will be able to construct and maintain field ditches or other measures with more assurance that these ditches will not fill up with sediment or scour out. These measures will carry excess water off their land.

The inputs of capital, labor, and management can be more intensively utilized when drainage is improved. More profitable cropping patterns can be used when the project is installed. The more productive crops, such as alfalfa, requiring well-drained land can be included in a cropping system. Some bottom land areas with a high level of flood protection below structure sites will have a potential for vegetable crop production. Production costs should decrease through less frequent replanting, less expense for seed bed preparation, weed and grass control and use of fewer chemicals.

Although there are few irrigation developments in the watershed at present, there will be a potential for additional development in the flood plain areas as a result of improved flood protection. Supplemental irrigation would be available particularly during summer drought periods. Water supply would be available for a limited period from structure reservoirs and from shallow wells located in the flood plain with predicted yields of 150-600 gallons per minute. Water supplies from all sources should be of suitable quality for irrigation purposes.

#### Fish and Wildlife and Recreation

Fifty-seven miles of perennial streams are recognized in the watershed. Eight miles of this perennial flow will be inundated by the proposed structures.

The proposed reservoir structures will change the status of the Little Black River from a "free flowing" stream to a partially controlled stream. 4/ Flows will become less sporadic and of longer duration, providing a more stable stream environment for all aquatic organisms. These stable conditions may influence stream ecology in several complex ways. Species unable to tolerate sporadic flows and occasional droughts may increase in numbers as suggested by Paloumpis. 28/

If spawning seasons of these species overlay with those of species currently dominating the ecosystem (e.g., smallmouth bass and rockbass), increased interspecific competition for food may result among the young immediately following dispersal from the nest. Pflieger suggests that this may be a potential factor in the mortality of smallmouth bass fry. 29/ Under these conditions natural recruitment of smallmouth bass could be reduced.

Water quality of area streams will improve with land treatment measures. Reduced sedimentation in spawning beds should increase hatching success of fish eggs; reduced turbidity should increase overall productivity of the aquatic ecosystem; and stabilization of stream banks and substrate should improve fish cover. These effects together with the stabilized stream flows, should increase carrying conditions of the stream fishery.

The release ports on structures A-3, B-9, C-7, and D-2 will discharge 0.8 c.f.s., 0.9 c.f.s., 0.5 c.f.s., and 0.2 c.f.s., respectively. In addition, appurtenances of all structures with drainage areas larger than 3.0 square miles will be installed with a bottom-water discharge principal spillway. They will insure that outfall water from these structures maintains or does not exceed stream temperatures of the Little Black River and will replace evaporation losses and prevent releases raising downstream water temperatures. These outlets will be designed to function similarly to those described by Dillon, et al. 30/ In this way reservoirs on all major intermittently flowing streams (i.e., those flowing in excess of 6 months out of the year) will not contribute warm surface water to the Little Black River. The above design features should prevent abnormal stream temperature rises and low flows on the Upper Little Black River.

The rate at which water enters and leaves mainstream reservoirs will be fairly short, and well-defined thermoclines are not expected. Therefore, water temperatures within the normal pool levels may permit maintenance of cool water species, and stocking programs for these species (smallmouth bass and walleye) may be possibilities for fisheries management. 4/

Water samples of the watershed indicate that moderately high phosphate concentrations are found in the stream waters. 4/ Increased production of algal and aquatic plants may occur in impoundments as a response to these higher phosphate levels. Magnitude of this production is not anticipated to cause a nuisance in any of the reservoirs of this watershed. Most structures have a high watershed pool area ratio and therefore fairly quick turnover of water and nutrients. This flushing action is considered a management problem for fisheries, therefore, any increased production potential offered by increased nutrient inflow may prove desirable.

Site B-9 selected as a multi-purpose recreation site is not expected to have nuisance algal or plant problems. Though phosphate amounts were higher than expected or desired, it is the only measurement taken that exceeded recommendations for recreation waters. 27/ Phosphate occurrence



in this upper watershed are from natural sources. No problems presently exist in the watershed area. Present oxygen demand, turbidity, suspended solids, and dissolved solids measurements 4/ were well below recommendations. 27/ Measurements 4/ of nitrogen/phosphorus ratio did not indicate a problem situation in spring of 1974.

Numbers of plankton organisms in the upper watershed are expected to increase considerably due to the water impoundments, resulting in overall increased aquatic productivity. The greatly increased volume of water will also produce much larger standing crops of fishes in the impoundments than are now found in the streams. However the species composition of the fishery will change, and the productive level considered optimum for fish production in Missouri will not be reached due to the large watershed ratios involved.

Species composition of benthic populations within impoundments are expected to change. Those typically found on depositing substrata will predominate. 31/ Total numbers of benthic organisms are also expected to increase which will result in an increase of fish food production.

Reservoirs and standing waters will collect phosphates from influent streams and store a portion of these in consolidated sediments. Algal blooms and aquatic plant problems may occur in the impoundments in response to the relatively high phosphate levels.

Reservoir-type structures will provide 1,053 acres of water. The 20 pools will vary in size from 11 to 298 acres. Average depth of pools will be 8 feet, ranging from 5.5 in D-12 to 12.0 feet in B-3. The pool areas of the 19 single-purpose flood prevention structures will function as sediment storage throughout the life of the project; therefore, this water resource will not be available for the entire 100-year life of the project.

The 298 acres provided by the multiple-purpose pool at structure B-9 will be available as aquatic habitat for the entire project period. Fish populations in the reservoir sediment pools should be expected to develop similar to those described by Patriarche and Campbell at Clearwater Lake. 32/ Species such as gizzard shad, bluegills, longear sunfish, white crappie, bullheads, and golden redhorse, all of which are either prolific spawners, omnivorous feeders, or both, will dominate during the first few years following impoundments. Spawning beds of the major stream species, particularly those of the smallmouth bass, will be inundated by the impoundments. Populations of these species should not be expected to reach large proportions within the impoundments without proper management. Mitigation features will help provide fish cover and thus increase standing crop of game fishes. The sediment pools will augment the warm water fishery resource of the area. Water fluctuation in flood pools and a high rate of water exchange lowers carrying conditions and management options of the fishery resource. Drainage area to reservoir pool area ratio ranges from 46:1 to 154:1. Maintaining balanced populations of desirable species will be the major management problem.



Shallow water areas will be created by 151 acres of the pools which will be less than 2 feet deep. Surrounding this shallow water area will be approximately 49 miles of shoreline. This aquatic "edge" will increase the various species associated with this environs.

Creation of the above sediment pools will increase the availability of water resources to area residents. Management and utilization of sediment pool resources will be under the control of involved land-owners.

Present land uses are not expected to change, and planned land treatment measures will not lower overall carrying capacities of present wildlife habitat. More intensive land uses can be anticipated for the 7,000 acres of cropland and 8,000 acres of pastureland planned for treatment. The effects will be minimal because all the cropland is located within the narrow band of the flood plain. The pasturelands are small tracts interspersed throughout the watershed. Loss of present habitat conditions because of water inundation of sediment pools is not considered significant.

The construction of the reservoir structures and the associated roads will create forest openings, thus creating more edge effects and habitat diversity for terrestrial wildlife. Increased human activity may adversely affect both deer and turkey populations in the upland areas.

Application of planned treatment measures in the 93,000 acres of forest land includes silviculture, harvest, and fire control operations. It is expected that most native wildlife will benefit. Planned woodland grazing systems or livestock exclusions of forest lands will increase wildlife carrying conditions. Where considerations are given in woodland operations to enhance wildlife needs, wildlife can be enhanced.

Several state-listed rare, endangered, or declining species of plants and animals occur or may occur in the project. In areas where structural works are to be installed, adverse affects to some of these species can be anticipated. Planned land treatment measures will not adversely affect listed species and improved management of woodlands and native pasturelands could enhance habitat. No project benefits are anticipated on the species considered nationally threatened--the Southern Bald Eagle, Indiana Bat, and Eastern Cougar. The Southern Bald Eagle is considered extirpated from the state, and the primary habitat of the Indiana Bat is in caves. No occurrence of cougar in the state has been verified for many years.

The recreation development is designed to accommodate 1,763 persons at one time for planned recreational activities of picnicking, boating, camping, playfields, fishing, nature trails and swimming. The primary recreation season extends from Memorial Day to Labor Day. A total of 63,468 days of recreation-use is estimated for the primary season. An additional 26,532 recreation days will occur during the remainder of the year. This recreation activity will be primarily for fishing.

## Effects of Works of Improvement

Estimated total annual visitation is 90,000 recreation days with an assigned value of \$2.25 per recreation day.

Favorable climatic conditions, combined with the proposed development, will attract many people during the recreational season. Local economy will be stimulated as business enterprises sell merchandise and provide services to people using facilities.

### Economic and Social

Information from the community profile for Ripley County states that the farm-operator family level of living index in 1959 was lower than 81 percent of the 3,135 United States counties. Unemployment and underemployment are persistent problems. The unemployed civilian labor force in Ripley County in 1960 was 7.3 percent, a somewhat higher proportion than the national rate of 5.6 percent. Ranked against the other counties, Ripley County had a higher rate of unemployment than 85 percent of the 3,135 counties in the United States. Eighty percent of all counties in the United States had a higher per capita disposable income than Ripley County in 1966. Since a large part of the watershed is in Ripley County and conditions are similar throughout the area, the census data for the county is considered representative.

Installation of the project will expand the economic base of the rural area. New jobs will be created as a result of the increased production and processing of agricultural products. Improved agricultural efficiency will allow more family farms to stay in business thereby reducing migration to the cities. As a result of stabilizing agriculture and increasing farm profits, the quality of living will be improved and progress will be made toward overall rural development.

The small number of people displaced by the project will not have a major effect on schools, churches, and other neighborhood groups.

There will be some interrupted traffic where flood pools inundate unimproved county roads. In flood plains areas, however, interruption of travel, mail deliveries, and work delays will be much less a problem with the installation of the project. The project will allow about \$5,000 annually, now spent on roads and bridges, to be used for other priority improvements.

Effects not evaluated in monetary values include: (1) the reduced threat of injury or loss of life that is directly associated with the velocity and depth of floodwaters, (2) hazards to health caused by contamination of wells and pollution from sewage systems, (3) reduced costs of activities that are necessary to control disease carrying insects and organisms after major floods, and (4) enhanced water quality as a result of land treatment and trapping effect of reservoirs.

## Effects of Works of Improvement

The proposed works of improvement will have little effect upon the mineral resources of the watershed. The large regional sand and gravel resource makes it unlikely that it would be necessary to utilize any sand and gravel present near the proposed structure sites. Because of deep overburden and large nearby supplies, it is doubtful that the stone near the proposed structures will become of economic importance. Clay, iron, and manganese deposits have been noted in Butler County. However, no such deposits were observed around any of the proposed works of improvement.



## PROJECT BENEFITS

Benefits accruing from the structural measures included in this plan amount to \$1,145,734 annually at current normalized prices. The benefits estimated to be derived from flood prevention total \$787,634; redevelopment, \$49,800; recreation, \$202,500; and local secondary, \$105,800. Since secondary benefits from a national viewpoint were not considered pertinent, none were evaluated.

Flood prevention benefits include \$378,376 in annual benefits accruing in the Lower Little Black Watershed and \$183,814 in annual benefits accruing downstream in the White River Basin. These benefits consist of a reduction in damages to crops, pastures, fences, roads, bridges, and farm buildings and a reduction in indirect losses. Installation of planned land treatment measures will provide additional flood damage reduction benefits of \$8,701 annually. Flood prevention benefits consist of \$707,309 in reduction of damages and \$80,325 in benefits from more intensive land use. This more intensive land use in the Lower Little Black Project is accruing to structural measures in this plan.

## COMPARISON OF BENEFITS AND COSTS

The average annual cost of structural measures is estimated to be \$719,665. The measures are expected to produce annual benefits, excluding secondary benefits, of \$1,039,934, or \$1.44 for each dollar cost.

The ratio of the total average annual benefits, \$1,145,734, to the average annual cost of structural measures, \$719,665, is 1.6:1.0.

## PROJECT INSTALLATION

Sponsoring local organizations, with the assistance of interested local, state and federal agencies and groups, will develop an educational program regarding watershed development. This program will help achieve understanding and stimulate participation in the project.

Land treatment itemized in Table 1 will be established during the project installation period by landowners and operators in cooperation with the soil and water conservation districts of their counties. The governing bodies of the soil and water conservation districts will arrange for meetings according to a definite schedule. They will set priorities on completed practices and otherwise assist and encourage landowners and operators to establish complete resource conservation plans. Technical assistance from the Soil Conservation Service and the Missouri Department of Conservation - Division of Forestry, in cooperation with the U.S. Forest Service, will be provided for planning and applying land treatment measures. The assistance will be accelerated to assure satisfactory planning progress and application of the planned measures within the project period.

Land treatment measures itemized in Table 1 on federally owned land will be installed in the Clark and Mark Twain National Forests by the U.S. Forest Service.

Seed, shrubs and trees in limited quantities which are not a part of wildlife mitigation measures will be provided by the Missouri Department of Conservation to establish food and cover for wildlife management areas within the limitations of existing agreements. Plantings of these materials will be on the basis of recommendations and guidance by the Missouri Conservation Department personnel. Protection from livestock must be assured.

The Soil Conservation Service will be responsible for all engineering except those pertaining to recreational facilities. The Soil Conservation Service will provide assistance in the design of recreation facilities; however, the primary responsibility for both the engineering and design will be with the Missouri Department of Natural Resources, Division of Parks and Recreation. This will be accomplished by an architectural and engineering contract. The Soil Conservation Service will review all designs prepared by architectural and engineering contracts. The Missouri Department of Natural Resources, Division of Parks and Recreation will be responsible for engineering on non-project items (two residences and associated utilities).

Little Black Watershed Subdistrict and the Missouri Department of Natural Resources, Division of Parks and Recreation are eligible under Missouri statutes to administer and contract for construction of all works of improvement in this plan. Both groups have the power of eminent domain. Construction will not begin on any structural measure until: (1) all land rights have been obtained for structural measures, or (2) a substantial part of the land rights have been obtained and a written statement furnished by the sponsors that all powers granted



## Project Installation

them by the state will be used, if necessary, to clear the remaining land rights within the project period and that funds are available for this purpose. All items will be installed by contract or force accounts. Appropriate project agreements will be executed prior to construction.

The Little Black Watershed Subdistrict will be responsible for contracting construction of all works of improvement on the 19 single-purpose flood retarding structures unless they, at a later date, request the Soil Conservation Service to administer the contracts. Missouri Department of Natural Resources, Division of Parks and Recreation will be responsible for construction of multipurpose structure B-9 but has requested the Soil Conservation Service to administer the construction contract. The Missouri Department of Natural Resources, Division of Parks and Recreation will also be responsible for construction contracting of recreational facilities and specific cost items.

If the sponsors perform the contracting, they will be responsible for establishing and maintaining a financial management system, including financial reporting requirements adequate to meet Federal procurement regulations. This system shall provide for accurate, current and complete disclosure of the financial results of each segment of the project in which Soil Conservation Service has a financial interest in accordance with Soil Conservation Service reporting requirements. These records must identify adequately the source and application of funds for the project. The sponsors must maintain effective control over and accountability for all funds, property and other assets. The sponsors procurement procedures shall be in writing and conform to Federal procurement regulations, Soil Conservation Service policies and procedures and applicable state and local laws. All accounting records must be supported by source documentations. The sponsor must schedule audits of the financial management system at reasonable frequency, usually annually, but not less than biannually, and assure timely and appropriate resolution of audit findings and recommendations.

The sponsor shall develop, maintain and enforce a written code or standards of conduct which shall govern the performance of its officers, employees, or agents in contracting with and expending PL-566 funds. As a minimum the standards shall provide that the sponsor officers, employees or agents, shall neither solicit nor accept gratuities, favors, or anything of monetary value from contractors or potential contractors. The contract or other procurement action shall not be awarded to a sponsor, or firms in which any official of such organizations or any member of such official's immediate family, has direct or indirect interest in the recurring profits or contracts of such firms. To the extent permissible by state or local law, rules or regulations, such standards shall provide for penalties, sanctions or other disciplinary actions to be applied for violations of such standards by either the CLO officers, employees, or agents, or by contractors or their agents.

The Little Black Watershed Subdistrict will be responsible for acquiring all land rights for single-purpose floodwater retarding structures. The



## Project Installation

subdistrict will acquire flowage easements on 154 acres associated with multipurpose structure B-9. These land rights include the land needed for structure sites and pools, preservation of a cemetery at site C-7, powerlines in sites A-2, and A-3, and modification of Highway 21 above site C-7. Land rights will also include rerouting, modification, or easements for temporary flooding of county roads in sites A-3, B-1, and B-9, a logging road in site C-7 and the removal of two vacant dwellings in site A-3 and C-7 and an occupied dwelling in site C-7.

The Missouri Department of Natural Resources, Division of Parks and Recreation will be responsible for purchasing in fee simple title approximately 1,311 acres of land for multipurpose structure site B-9 related recreation facilities. This will involve acquiring one farm operation, with residence, and modification of a pipeline.

The subdistrict will be responsible for relocating one family in site C-7. The Missouri Department of Natural Resources, Division of Parks and Recreation will be responsible for relocating one farm operation including residence in site B-9. As part of project administration, the subdistrict and Missouri Department of Natural Resources, Division of Parks and Recreation will: (1) provide personally or by first class mail written notice of displacement and appropriate forms to each displaced person, business, or farm operation; (2) assist in filing applications; (3) review and approve applications for relocation assistance; (4) review and process grievances in connection with displacements; and (5) make relocation payments.

The Soil Conservation Service will assist sponsors in fulfilling their responsibilities.

As a part of project administration, the subdistrict and the Missouri Department of Natural Resources, Division of Parks and Recreation will provide, without PL-566 cost sharing, relocation advisory assistance services as may be needed in connection with the relocation of displaced persons, businesses, or farming operations. These services include:

1. Determining the need, if any, of displaced persons for relocation assistance.
2. Providing current and continuing information on the availability, prices, and rentals of decent, safe, and sanitary sale and rental housing and of comparable commercial properties and locations for displaced businesses and farm operations.

## Project Installation

3. Assuring that replacement dwellings will be available within a reasonable period of time prior to displacement.
4. Assisting a person displaced from his business or farm operation in obtaining and becoming established in a suitable replacement location.
5. Supplying information concerning housing programs, disaster loan programs and other federal or state programs, and offering assistance to displaced persons.
6. Providing other advisory services to displaced persons in order to minimize hardships to such persons in adjusting to relocation.
7. Advising displaced persons that they should notify the displacing agency before they move.
8. Providing persons from whom it is planned to acquire land a brochure or pamphlet outlining the benefits to which they may be entitled prior to initiation of acquisition.

The sponsors have determined that decent, safe, and sanitary replacement housing will be available for all persons subject to displacement by the project. All displaced persons will be given notice to vacate at least 90 days before they have to move.

In the A subwatershed and B subwatershed, the upper structures in the series will be built ahead of, or concurrently with, the lowest or last structure in the series; that is, A-2 and A-7 before A-3, and B-1, B-2, B-3, and B-4 ahead of B-9. Dams totaling 1,000 to 1,200 c.f.s. release flow from low and single stage inlets will be built in the Upper Little Black Project before the diversion structure and floodway diversion are built in the Lower Little Black Project. Channel construction in the Lower Little Black will be done concurrently with dam construction.

The following other pertinent provisions of the law, regulations, and policies shall be met before issuance of invitations to bid on any portion of the installation of works of improvement:

1. Mutual agreement on schedules of construction, plans, and specifications shall be reached. Terms of contracts and all matters pertaining to contracts for works of improvement shall be mutually satisfactory in accordance with Soil Conservation Service technical and administrative specifications.

## Project Installation

2. Land rights, except for multiple-purpose structure B-9, shall be secured at no cost to PL-566 funds, and valid ownership therefor presented to the mutual satisfaction of all parties.
3. Full conformance with state laws and regulations shall be the responsibility of the sponsors and shall be secured at no cost to the federal government. Reasonable evidence of conformity shall be presented to the mutual satisfaction of all parties.
4. Needed land treatment must be applied prior to construction or concurrently with construction of the proposed structural measures.
5. Agreements for operation and maintenance of works of improvement to be installed shall be secured.



## FINANCING PROJECT INSTALLATION

Federal assistance will be provided under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, 68 Statute 666), as amended. This assistance is subject to appropriation of funds.

The cost of land treatment measures will be financed by the landowners and operators with assistance from federal and/or state programs. The total cost of installing land treatment measures, including forest land treatment measures on private forest and national forest lands, is estimated to be \$750,100. The Soil Conservation Service will provide \$105,000 in technical assistance to apply land treatment measures, \$45,000 of which will be funded by the going program and \$60,000 by PL-566 funds. Technical assistance to private landowners for installation of forest measures will be provided as follows: PL-566 funds, \$61,600; the Missouri Department of Conservation - Division of Forestry, \$11,600; and the Cooperative Forest Management Program, \$46,500. The estimated installation cost of land treatment measures for private landowners is \$493,700 (\$280,000 for cropland, \$120,000 for grassland, and \$93,700 for forest land). The U.S. Forest Service will provide \$23,800 for the installation of land treatment measures and related activities on the Mark Twain and Clark National Forests with regular program funds.

The proportional project share in the cost of additional fire suppression equipment to be used for intensification of fire protection will be provided by PL-566 funds, \$4,500, and the State of Missouri, \$3,400.

Table 1 shows the extent of land treatment programed for this project and the amount of accelerated technical assistance.

Installation of measures on national forest lands will be financed with regular appropriations as such funds are made available for this purpose.

It is expected that cost-sharing under the Rural Environmental Conservation Program (RECP) will be available to qualified landowners for installing land treatment measures.

The Soil and Water Conservation Districts of Butler, Carter, and Ripley Counties organized a watershed subdistrict in Missouri. The subdistrict has the legal authority to levy taxes for expenses to carry out the project. The Little Black Watershed Subdistrict anticipates that loans will be necessary to finance land rights for the floodwater retarding structures in Upper Little Black Watershed. A letter of intent has been filed with the Farmers Home Administration for a loan of approximately \$45,000 to purchase land rights.

The Missouri Department of Natural Resources, Division of Parks and Recreation will finance its share of the project cost by securing appropriations through the normal legislative process. The local share of relocation payments and the total cost of relocation advisory services will be financed by the Little Black Watershed Subdistrict from tax levies made against real property in the subdistrict and by the Missouri Department of Natural Resources, Division of Parks and Recreation from its appropriation.

## Financing Project Installation

Sponsors must account to Soil Conservation Service for certain income earned by them during the "grant period". The grant period for this purpose is from the effective date of the Soil Conservation Service-fund obligating agreement until the date on which Soil Conservation Service formally notifies the sponsors that the undertaking has been completed to the satisfaction of Soil Conservation Service. Program income may include, but will not be limited to, income from service fees, usage or rental fees, and sale of assets purchased with Federal funds under a Soil Conservation Service-fund obligating agreement. This does not include fees collected for operating and maintaining recreational facilities that are a part of the Works of Improvement.

## PROVISIONS FOR OPERATION AND MAINTENANCE

Land treatment measures will be maintained by landowners and operators cooperating with the soil and water conservation districts as described in their conservation plans. Representatives of the subdistrict and the Soil Conservation Service will periodically inspect land treatment measures, and the district will encourage farmers to perform needed maintenance.

The forest land treatment measures installed on private land will be maintained by the landowners with technical assistance furnished by the Missouri Department of Conservation - Division of Forestry, in cooperation with the U.S. Forest Service under the going Cooperative Forestry Management Program. The U.S. Forest Service will maintain measures installed on the National Forest lands. Other current federal-state forestry programs include Cooperative Forestation, Cooperative Insect and Disease Control and Cooperative Forest Fire Control.

The 19 floodwater retarding structures will be operated and maintained at an estimated annual cost of \$23,410 by the Little Black Watershed Subdistrict. Funds for paying these operation and maintenance costs will be obtained from taxes levied in the watershed area.

Multipurpose structure B-9 and associated recreational facilities will be operated and maintained by the Missouri Department of Natural Resources, Division of Parks and Recreation. The estimated annual cost is \$7,352 for the structure, \$51,578 for the recreation facilities, making a total of \$58,930 annually. The above cost includes a replacement cost of \$19,178 for recreational facilities. Major items expected to be replaced include picnic tables, grills, trash can units, toilets, signs and water supply facilities. Funds for these costs will be included in the annual budget for operating the state park system.

Operation and maintenance costs for the structures include, but are not limited to, replacing and repairing riprap, mowing embankments and spillways where necessary to control weeds, controlling woody vegetation, repairing rodent damage, and removing debris around the riser.

The gates on structures A-3, B-9, C-7 and D-2 will be manually operated by the watershed subdistrict in cooperation with the joint board of the Butler County Drainage District No. 10 and the Naylor Drainage District. The gates will normally be kept open but will be closed to minimize flooding along the floodway. A staff gage will be installed near the road bridge over the Little Black in the NE 1/4 of Section 24, T23N, R4E to control opening and closing of the gates. The gates will be closed when flow exceeds 1,900 c.f.s. at the staff gage. Individual and/or all of the gates may be opened when the discharge at the staff gage recedes to less than 2,450 c.f.s. The individual structure gates will be opened within 5 days after pool elevation has dropped to the high stage elevation.



## Provisions for Operation and Maintenance

Where latent defects become apparent during the establishment period, the Soil Conservation Service will share the cost of repair at the same rate as original cost of construction. For structural measures the establishment period shall extend 3 years from the date of acceptance of the structural works of improvement. The establishment period for vegetative work associated with a structural measure is a period from date of acceptance of the initial vegetative work to midnight of the date on which the Soil Conservation Service writes the sponsor advising that adequate vegetative cover has been obtained. This period shall not, however, exceed two growing seasons or the end of the establishment period for the associated structural measure whichever is greater in time.

The Soil Conservation Service and the sponsors will make joint inspections annually, after each severe flood and after the occurrence of any other unusual condition which might adversely affect the structural and mitigation measures. These inspections will continue 3 years following the installation of each structural work of improvement. Such inspections will also be made by the sponsors after the 3-year period and a report furnished to the Soil Conservation Service. Inspection of the flood-water retarding structures will include the condition of the principal spillway and its appurtenances, the emergency spillway, the earthfill, the vegetation, riprap, and other items installed as a part of the structure. These inspections will also include the sanitary facilities provided at sites A-3 and C-7 where public access will be provided.

An operation and maintenance agreement will be developed by the Soil Conservation Service for all structural measures in the watershed prior to the issuance of an invitation to bid on the first contract. A separate operation and maintenance plan will be prepared for each similar group of structural measures. The operation and maintenance agreements will refer to the Missouri Soil Conservation Service Watershed Operation and Maintenance Handbook.

The O & M agreement will delineate specific requirements relative to retention and disposal of real and personal property acquired in whole or in part with PL-566 funds. Disposal will, as a minimum, require prior concurrence of the Soil Conservation Service and in most instances reimbursement to the Soil Conservation Service for that portion originally cost shared.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST  
Upper Little Black Watershed, Missouri

Installation Cost Item	Unit	Number	Estimated Cost (Dollars) a/										
			Fed. Land	Non-Fed. Land	Total	P.L. 566 Funds				Total			
						Federal Land		Non-Federal Land			Other Funds		
						SCS g/	FS g/	SCS g/	FS g/			SCS g/	FS g/
LAND TREATMENT Land Areas b/	Acres to be treated	7,000	7,000										
		8,000	8,000										
		890	42,120	43,010					23,800		93,700		

<sup>a/</sup> Price base 1973.

<sup>b/</sup> Includes only areas estimated to be adequately treated during the project installation period. Treatment will be accelerated throughout the watershed, and dollar amounts apply to total land areas, not just to adequately treated areas.

<sup>c/</sup> Federal agency responsible for assisting in installation of works of improvement.

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TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

Upper Little Black Watershed, Missouri

Measures	Unit	Applied to Date	Total Cost (Dollars) <u>a/</u>
<u>LAND TREATMENT</u>			
Brush Control	Acre	3,990	53,865
Conservation Cropping Systems	Acre	3,026	18,153
Crop Residue Management	Acre	3,913	54,782
Pond	No.	185	148,000
Drainage Mains and Laterals	Feet	36,960	17,500
Pasture and Hayland Management	Acre	7,436	185,900
Pasture and Hayland Planting	Acre	8,250	495,000
Drainage Field Ditches	Feet	36,960	5,600
Forest Management Plans (60 plans)	Acre	5,565	7,600
Tree Planting	Acre	300	12,600
Hydrologic Cultural Operations	Acre	6,620	165,300
Fire Control	Acre	93,562	163,500
Wildlife Ponds	No.	3	3,600
TOTAL			1,331,400

a/ Price base 1973.

June 1974



TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION  
Upper Little Black Watershed, Missouri  
Dollars <sup>a/</sup>

Item	Installation Cost - P.L. 566 Funds				Installation Cost - Other Funds				Total Installation Cost
	Construction	Engineering	Land Rights	Relocation Payments	Total PL-566	Construction	Engineering	Land Rights	Relocation Payments
Floodwater Retarding Structures:									
A-2	483,000	48,300			531,300			26,760	
A-3	747,600	74,800			822,400			50,375	
A-5	96,400	9,600			106,000			3,190	
A-7	389,000	38,900			427,900			16,390	
A-13	92,700	9,300			102,000			3,485	
B-1	560,000	56,000			616,000			24,870	
B-2	528,000	52,800			580,800			19,400	
B-3	209,300	20,900			230,200			5,945	
B-4	167,700	16,800			184,500			6,620	
C-7	1,005,000	100,500		8,630	1,114,130			75,090 <sup>a/</sup>	1,370
D-1	129,700	13,000			142,700			4,565	
D-2	790,000	79,000			869,000			13,000	
D-3	59,600	6,000			65,600			1,955	
D-4	109,300	10,900			120,200			3,690	
D-5	148,600	14,900			163,500			4,065	
D-7	86,700	8,700			95,400			3,000	
D-8	83,500	8,400			91,900			2,760	
D-9	61,000	6,000			67,000			1,995	
D-12	105,600	10,600			116,200			3,530	
Subtotal F.R. Structures	5,852,700	585,400		8,630	6,446,730			270,685 <sup>b/</sup>	1,370
Multiple-Purpose Str. B-9	1,702,907	184,000	74,500 <sup>c/</sup>	8,630	1,970,037	135,093		93,750 <sup>c/</sup>	1,370
Recreation Facilities Non-Project Cost	335,910	33,590 <sup>b/</sup>	102,625		472,125	335,910 (56,500) <sup>e/</sup>	33,590 <sup>b/</sup>	102,625	
Subtotal M.P. Structures	2,038,817	217,590	177,125	8,630	2,442,162	471,003		196,375	1,370
TOTAL STRUCTURAL MEASURES	7,891,517	802,990	177,125	17,260	8,888,892	471,003		467,060	2,740
Project Administration					1,379,900				
GRAND TOTAL	7,891,517	802,990	177,125	17,260	10,268,792	471,003		467,060 <sup>f/</sup>	2,740
								1,015,293	
									11,284,085

<sup>a/</sup> Price Base 1973.  
<sup>b/</sup> A&E Contract - cost to be borne 50 percent by PL-566 & 50 percent by Other Funds.  
<sup>c/</sup> Includes \$3,250 for berm over pipeline & \$10,000 for moving farmstead & camp buildings.  
<sup>d/</sup> Includes \$1,000 relocation advisory assistance services.  
<sup>e/</sup> Non-project costs associated with installation of superintendent and assistant superintendent residences & related utilities.  
<sup>f/</sup> Includes \$6,440 for legal fees, surveys, easement damage, & appraisals.  
<sup>g/</sup> Includes \$21,866 for cemetery levee or mound.  
<sup>h/</sup> Includes \$2,000 for moving a powerline at Structure A-2 & A-3.  
<sup>i/</sup> Includes \$15,000 for rerouting or modification of Highway 21.

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TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY  
Upper Little Black Watershed, Missouri

(Dollars) a/

Item	COST ALLOCATION			COST SHARING				
	PURPOSE			P.L. 566		OTHER		
	Flood Prevention	Recreation	Total	Flood Prevention	Recreation	Flood Prevention	Recreation	Total
Flood Retarding Structures	6,718,785		6,718,785	6,446,730		6,446,730	272,055	272,055
Multiple-Purpose Structures	1,637,307	562,943	2,200,250	1,616,888	353,149	1,970,037	20,419	209,794
Recreation Facilities		944,250	944,250		472,125	472,125	472,125	472,125
TOTAL	8,356,092	1,507,193	9,863,285	8,063,618	825,274	8,888,892	292,474	681,919
								974,393

a/ Price Base 1973.

June 1974





TABLE 2B - RECREATIONAL FACILITIES  
ESTIMATED CONSTRUCTION COSTS  
Upper Little Black Watershed, Missouri

(Dollars) a/

Page 1 of 4

Item	Units	Quantity <u>b/</u>	Unit Cost	Construc- tion cost
Roads - Dual Lane Graveled				
From North to swim area	L.F.	3,000	5	15,000
From Highway K to swim area	L.F.	4,800	5	24,000
From swim area through group camp	L.F.	2,200	5	11,000
Site Preparation & Landscaping				
Clearing, grubbing & landscaping	Ac.	60	200	12,000
Seeding, mulching, fertilizer & labor	Ac.	60	200	12,000
Planting trees and shrubs	-	L.S.	5,000	5,000
Miscellaneous				
Information Signs	Ea.	4	250	1,000
Park and entrance signs	Ea.	2	1,500	3,000
Wildlife signs	Ea.	200	50	10,000
Electric power lines	L.F.	12,000	3	36,000
Camp area roads	L.F.	8,000	5	40,000
Water distribution lines	L.F.	10,000	8	80,000
Water supply tower	-	L.S.	5,000	5,000
Natural trail	L.F.	4,400	1.25	5,500
Directional signs	-	L.S.	1,000	1,000
Group Camp Areas (2)				
Picnic tables	Ea.	20	65	1,300
Grills	Ea.	40	80	3,200
Toilets - vault type - double unit	Ea.	2	2,000	4,000
Water hydrant	Ea.	2	100	200
Shelter (20' X 40') <u>d/</u>	Ea.	4	6,000	24,000
Parking spaces	Ea.	20	50	1,000
Trash can units - 2 can	Ea.	10	50	500
Overlook & Picnic Area				
Picnic tables	Ea.	4	65	260
Grills	Ea.	4	80	320
Trash can units - 2 can	Ea.	2	50	100
Toilet - vault type - double unit	Ea.	1	2,000	2,000
Parking spaces (10' X 20')	Ea.	10	50	500
Boat Launch & Picnic Area				
Parking spaces (10' X 40')	Ea.	30	110	3,300
Parking spaces (10' X 20')	Ea.	10	50	500
Picnic tables	Ea.	10	65	650
Grills	Ea.	10	80	800
Trash can unit - 2 can	Ea.	7	50	350
Toilet - vault type - double unit	Ea.	1	2,000	2,000
Boat launch ramp - 14' concrete	L.F.	200	55	11,000
Water hydrant	Ea.	2	100	200



TABLE 2B - RECREATIONAL FACILITIES  
ESTIMATED CONSTRUCTION COSTS  
Upper Little Black Watershed, Missouri

Page 2 of 4

(Dollars) a/

Item	Units	Quantity <u>b/</u>	Unit Cost	Construc- tion Cost
<b>Swimming Area</b>				
Sand beach - 12' sand depth	S.F.	74,000	0.50	37,000
Change house with toilets	Ea.	1	12,000	12,000
Parking spaces (10' X 20')	Ea.	200	50	10,000
Drinking fountain	Ea.	2	350	700
Trash can units - 2 can	Ea.	10	50	500
Life guard chair	Ea.	2	250	500
Diving platform	Ea.	2	1,200	2,400
<b>Interpretive Area</b>				
Parking spaces (10' X 20')	Ea.	25	50	1,250
Picnic tables	Ea.	14	65	910
Grills	Ea.	14	80	1,120
Trash can units - 2 can	Ea.	10	50	500
Information signs	Ea.	2	250	500
<b>Walk In Picnic Area</b>				
Walking bridge	Ea.	1	1,150	1,150
Picnic tables	Ea.	38	65	2,470
Grills	Ea.	38	80	3,040
Trash can units - 2 can	Ea.	10	50	500
Toilet - vault type - double unit	Ea.	2	2,000	4,000
Information signs	Ea.	1	250	250
Drinking fountain	Ea.	1	350	350
Playground equipment	-	L.S.	3,000	3,000
<b>Parking &amp; Picnic Area</b>				
Parking spaces (10' X 20')	Ea.	100	50	5,000
Trail to fishing	L.F.	1,000	1.25	1,250
Shelter unit - (20' X 40') <u>d/</u>	-	L.S.	7,500	7,500
<b>Primitive Camp Area</b>				
Toilet - vault type - double unit	Ea.	1	2,000	2,000
Development of camp area	-	L.S.	2,000	2,000
Back pack trail	-	L.S.	3,000	3,000
<b>Picnic Area Along Creek</b>				
Picnic tables	Ea.	20	65	1,300
Grills	Ea.	20	80	1,600
Water hydrant	Ea.	2	100	200
Toilet - vault type - double unit	Ea.	1	2,000	2,000
Canoe put in - gravel	-	L.S.	1,500	1,500
Parking spaces (10' X 20')	Ea.	20	50	1,000
Road - gravel two way	L.F.	1,000	5	5,000
Information signs	Ea.	1	250	250
Drinking fountain	Ea.	1	350	350





TABLE 2B - RECREATIONAL FACILITIES  
ESTIMATED CONSTRUCTION COSTS  
Upper Little Black Watershed, Missouri

(Dollars) <sup>a/</sup>

Page 3 of 4

Item	Units	Quantity <u>b/</u>	Unit Cost	Construc- tion Cost
<b>Central Picnic Area</b>				
Picnic tables	Ea.	125	65	8,125
Grills	Ea.	100	80	8,000
Shelter units (20' X 40') <u>d/</u>	Ea.	2	7,500	15,000
Parking spaces (10' X 20')	Ea.	75	50	3,750
Play field	-	L.S.	4,000	4,000
Drinking fountains	Ea.	3	350	1,050
Water hydrants	Ea.	3	100	300
Playground equipment	-	L.S.	3,500	3,500
Toilet - vault type - double unit	Ea.	2	2,000	4,000
<b>Campground #1</b>				
Camping spaces <u>c/</u>	Ea.	74	900	66,600
Parking spaces	Ea.	10	50	500
Picnic tables	Ea.	10	65	650
Grills	Ea.	5	80	400
Trash can units - 2 can	Ea.	3	50	150
Restroom - flush type with showers (23' X 24') <u>e/</u>	Ea.	1	24,500	24,500
Information signs	Ea.	2	250	500
Drinking fountains	Ea.	2	350	700
Water hydrants	Ea.	2	100	200
Sanitary dump station	Ea.	1	1,000	1,000
<b>Campground #2</b>				
Camping spaces <u>c/</u>	Ea.	55	900	49,500
Restroom - flush type (18' X 20') <u>f/</u>	Ea.	2	9,500	19,000
Picnic tables	Ea.	5	65	325
Information signs	Ea.	2	250	500
Drinking fountains	Ea.	2	350	700
Water hydrants	Ea.	2	100	200
Grills	Ea.	5	80	400
<b>Service Area Complex</b>				
Parking spaces (10' X 20')	Ea.	10	50	500
Service building	-	L.S.	13,000	13,000
Sewer system	-	L.S.	5,000	5,000
Water system	-	L.S.	1,000	1,000
Electric lines	L.F.	2,000	3	6,000
<b>Subtotal Recreational Facilities Cost (Eligible for cost share)</b>				<b>671,820</b>





TABLE 2B - RECREATIONAL FACILITIES  
ESTIMATED CONSTRUCTION COSTS  
Upper Little Black Watershed, Missouri

(Dollars) a/

Page 4 of 4

Item	Units	Quantity <u>b/</u>	Unit Cost	Construc- tion Cost
Superintendent's Area - Non-Project Cost				
Supt. residence <u>g/</u>	-	L.S.	25,000	(25,000)
Assist. supt. residence <u>g/</u>	-	L.S.	25,000	(25,000)
Sewer System <u>g/</u>	L.F.	500	6.50	(3,250)
Water system <u>g/</u>	L.F.	500	3.50	(1,750)
Electric lines <u>g/</u>	L.F.	500	3	(1,500)
Total Non-Project Cost				(56,500)
Total Recreational Facilities Cost	-	-	-	671,820

a/ Price Base 1973.

b/ Estimated quantities subject to minor variations at time of detailed planning.

c/ Camp sites include 1 picnic table, 1 grill, parking space, traffic barriers, 1 waste receptacle, grading, and prorated share of access road.

d/ Shelter units include 10 tables, bulletin board, drinking fountain, and a masonry grill with chimney.

e/ Men's side will contain 4 water closets, 4 urinals, 4 showers, and 4 lavatories. Women's side will contain 8 water closets, 4 showers, and 4 lavatories.

f/ Men's side will contain 3 water closets, 3 urinals, 3 showers, and 3 lavatories. Women's side will contain 6 water closets, 3 showers, and 3 lavatories.

g/ No cost sharing.

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TABLE 3 - STRUCTURAL DATA  
STRUCTURES WITH PLANNED STORAGE CAPACITY  
Upper Little Black Watershed, Missouri

Page 1 of 5

ITEM	UNIT	Structure Number			
		A-2	A-3	A-5	A-7
Class of Structure	-	"b"	"b"	"a"	"b"
Drainage Area (Total)	Sq.Mi.	13.98	39.54	1.68	10.17
Controlled	Sq.Mi.	-	24.15	-	-
Curve No. (1-day) (AMC II)	-	77	77	77	77
Elevation Top of Dam	Feet	531.9	415.8	409.2	556.6
Elevation Crest Emergency Spillway	Feet	523.5	406.9	406.5	548.5
Elevation Crest High Stage Inlet	Feet	496.8	398.5	393.6	523.4
Elevation Crest Low Stage Inlet	Feet	-	380.7	-	-
Maximum Height of Dam	Feet	66.2	52.8	32.2	51.6
Volume of Fill	Cu.Yds.	364,000	218,500	64,100	272,300
Total Capacity <u>a/</u>	Ac.Ft.	4750	9878	450	4189
Sediment Submerged	Ac.Ft.	647	712	101	486
Sediment Aerated	Ac.Ft.	66	73	10	50
Beneficial Use Recreation	Ac.Ft.	-	-	-	-
Retarding	Ac.Ft.	4037	9093	339	3653
Between High and Low Stage	Ac.Ft.	-	4910	-	-
Surface Area	-	-	-	-	-
Sediment Pool <u>b/</u>	Acres	69.9	127.0	16.5	64.0
Beneficial Use Pool Recreation	Acres	-	-	-	-
Retarding Pool <u>a/</u>	Acres	239.8	585.0	36.6	238.0
Principal Spillway Design	-	-	-	-	-
Rainfall Volume (areal) (1 day)	Inches	7.57	7.48	6.20	7.66
Rainfall Volume (areal) (10 day)	Inches	14.84	14.69	12.00	14.91
Runoff Volume (10 day)	Inches	9.18	9.05	6.72	9.25
Capacity of Low Stage (Max.)	cfs	-	199	-	-
Capacity of High Stage (Max.)	cfs	383	2027	31	256
Frequency Operation - Emerg. Splwy.	% chance	<1	<1	4	<1
Dimensions of Conduit	Ft.or In.	48"	6'x12'	18"	42"
Emergency Spillway Design	-	-	-	-	-
Rainfall Volume (ESH) (areal)	Inches	8.04	8.05	5.42	8.20
Runoff Volume (ESH)	Inches	5.31	5.32	2.98	5.45
Storm Duration	Hours	6	6	6	6
Type	-	Veg.	Veg.	Veg.	Veg.
Bottom Width	Feet	400	350	30	200
Velocity of Flow (V <sub>e</sub> )	Ft./Sec.	-	-	-	-
Slope of Exit Channel	Ft./Ft.	0.140	0.150	0.040	0.040
Max. Reservoir Water Surface Elev.	Feet	522.0	406.7	404.4	545.2
Freeboard Design	-	-	-	-	-
Rainfall Volume (FH) (areal) (-hrs)	Inches	14.38	14.23	8.20	14.60
Runoff Volume (FH)	Inches	11.32	11.18	5.45	11.54
Storm Duration	Hours	6	6	6	6
Max. Reservoir Water Surface Elev.	Feet	528.8	413.3	409.2	554.1
Capacity Equivalents	-	-	-	-	-
Sediment Volume	Inches	.96	.96	1.24	.99
Retarding Volume	Inches	5.41	11.08	3.78	6.74
Beneficial Volume	Inches	-	-	-	-

a/ Crest of Emergency Spillway.

b/ Area to be shown in ( ) if reservoir contains beneficial storage or if sediment capacity will not store water.





TABLE 3 - STRUCTURAL DATA  
STRUCTURES WITH PLANNED STORAGE CAPACITY  
Upper Little Black Watershed, Missouri

Page 2 of 5

ITEM	UNIT	Structure Number			
		A-13 "a"	B-1 "b"	B-2 "c"	B-3 "a"
Class of Structure	-	-	-	-	-
Drainage Area (Total)	Sq.Mi.	2.13	12.11	4.45	2.51
Controlled	Sq.Mi.	-	-	-	-
Curve No. (1-day) (AMC II)	-	77	69	69	69
Elevation Top of Dam	Feet	410.8	634.7	673.7	627.5
Elevation Crest Emergency Spillway	Feet	407.4	625.9	662.8	622.1
Elevation Crest High Stage Inlet	Feet	395.2	607.5	638.7	599.8
Elevation Crest Low Stage Inlet	Feet	-	-	-	-
Maximum Height of Dam	Feet	35.8	46.7	56.2	54.5
Volume of Fill	Cu.Yds.	57,000	427,000	398,000	168,800
Total Capacity <u>a/</u>	Ac.Ft.	473	3177	1960	619
Sediment Submerged	Ac.Ft.	126	556	229	145
Sediment Aerated	Ac.Ft.	13	80	23	15
Beneficial Use Recreation	Ac.Ft.	-	-	-	-
Retarding	Ac.Ft.	334	2541	1708	459
Between High and Low Stage	Ac.Ft.	-	-	-	-
Surface Area	-	-	-	-	-
Sediment Pool <u>b/</u>	Acres	16.8	78.8	29.0	11.8
Beneficial Use Pool Recreation	Acres	-	-	-	-
Retarding Pool <u>a/</u>	Acres	41.6	219.0	127.0	37.0
Principal Spillway Design	-	-	-	-	-
Rainfall Volume (areal) (1 day)	Inches	6.20	7.54	8.79	7.61
Rainfall Volume (areal) (10 day)	Inches	12.00	14.66	16.92	14.73
Runoff Volume (10 day)	Inches	6.72	7.22	9.10	7.28
Capacity of Low Stage (Max.)	cfs	-	-	-	-
Capacity of High Stage (Max.)	cfs	68	274	108	70
Frequency Operation - Emerg. Splwy.	% chance	4	<1	<1	<1
Dimensions of Conduit	Ft.or In.	24"	48"	30"	24"
Emergency Spillway Design	-	-	-	-	-
Rainfall Volume (ESH) (areal)	Inches	5.42	8.12	11.55	8.19
Runoff Volume (ESH)	Inches	2.98	4.45	7.49	4.51
Storm Duration	Hours	6	6	6	6
Type	-	Veg.	Veg.	Veg.	Veg.
Bottom Width	Feet	30	200	200	100
Velocity of Flow (V <sub>e</sub> )	Ft./Sec.	-	3.17	4.09	5.34
Slope of Exit Channel	Ft./Ft.	0.030	0.055	0.070	0.025
Max. Reservoir Water Surface Elev.	Feet	407.0	626.7	663.0	623.8
Freeboard Design	-	-	-	-	-
Rainfall Volume (FH) (areal) (-hrs)	Inches	8.20	14.45	28.60	14.65
Runoff Volume (FH)	Inches	5.45	10.17	23.83	10.36
Storm Duration	Hours	6	6	6	6
Max. Reservoir Water Surface Elev.	Feet	410.8	632.6	670.9	627.5
Capacity Equivalents	-	-	-	-	-
Sediment Volume	Inches	1.22	0.98	1.06	1.20
Retarding Volume	Inches	2.94	3.93	7.20	3.43
Beneficial Volume	Inches	-	-	-	-

a/ Crest of Emergency Spillway.

b/ Area to be shown in ( ) if reservoir contains beneficial storage or if sediment capacity will not store water.

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TABLE 3 - STRUCTURAL DATA  
STRUCTURES WITH PLANNED STORAGE CAPACITY  
Upper Little Black Watershed, Missouri

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ITEM	UNIT	Structure Number			
		B-4	B-9	C-7	D-1
Class of Structure	-	"a"	"b"	"b"	"a"
Drainage Area (Total)	Sq.Mi.	2.87	47.51	27.41	2.88
Controlled	Sq.Mi.	-	21.94	-	-
Curve No. (1-day) (AMC II)	-	69	69	74	69
Elevation Top of Dam	Feet	586.6	482.9	507.5	419.4
Elevation Crest Emergency Spillway	Feet	581.1	462.8	497.1	415.9
Elevation Crest High Stage Inlet	Feet	565.3	450.8	482.7	405.2
Elevation Crest Low Stage Inlet	Feet	-	440.0	466.2	-
Maximum Height of Dam	Feet	45.1	73.5	63.5	33.4
Volume of Fill	Cu.Yds.	111,600	813,300	528,400	65,100
Total Capacity <u>a/</u>	Ac.Ft.	754	15,047	9,556	564
Sediment Submerged	Ac.Ft.	162	1,133	1,239	163
Sediment Aerated	Ac.Ft.	16	115	124	16
Beneficial Use Recreation	Ac.Ft.	-	2,213	-	-
Retarding	Ac.Ft.	576	11,586	8,193	385
Between High and Low Stage	Ac.Ft.	-	4,293	3,069	-
Surface Area					
Sediment Pool <u>b/</u>	Acres	20.5	157.0	136.1	25.4
Beneficial Use Pool Recreation	Acres	-	298.0	-	-
Retarding Pool <u>a/</u>	Acres	55.0	613.0	433.4	51.7
Principal Spillway Design					
Rainfall Volume (areal) (1 day)	Inches	7.61	7.34	7.39	6.20
Rainfall Volume (areal) (10 day)	Inches	14.73	14.45	14.63	12.00
Runoff Volume (10 day)	Inches	7.28	7.05	8.31	5.12
Capacity of Low Stage (Max.)	cfs	-	194	144	-
Capacity of High Stage (Max.)	cfs	66	1,948	1,627	65
Frequency Operation - Emerg. Splwy.	% chance	<1	<1	<1	4
Dimensions of Conduit	Ft.or In.	24"	5.5'x11'	5'x10'	24"
Emergency Spillway Design					
Rainfall Volume (ESH) (areal)	Inches	8.19	7.94	7.85	5.42
Runoff Volume (ESH)	Inches	4.51	4.29	4.79	2.27
Storm Duration	Hours	6	7	7	6
Type	-	Veg.	Rock	Veg.	Veg.
Bottom Width	Feet	80	100	250	40
Velocity of Flow (V)	Ft./Sec.	5.03	-	3.30	-
Slope of Exit Channel	Ft./Ft.	0.040	0.030	0.025	0.040
Max. Reservoir Water Surface Elev.	Feet	582.4	459.8	497.9	414.6
Freeboard Design					
Rainfall Volume (FH) (areal) (-hrs)	Inches	14.56	14.19	14.06	8.20
Runoff Volume (FH)	Inches	10.28	9.93	10.57	4.52
Storm Duration	Hours	6	7	7	6
Max. Reservoir Water Surface Elev.	Feet	586.6	479.4	504.5	419.4
Capacity Equivalents					
Sediment Volume	Inches	1.16	.92	.93	1.16
Retarding Volume	Inches	3.76	8.50	5.60	2.51
Beneficial Volume	Inches	-	1.62	-	-

a/ Crest of Emergency Spillway.

b/ Area to be shown in ( ) if reservoir contains beneficial storage or if sediment capacity will not store water.

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TABLE 3 - STRUCTURAL DATA  
STRUCTURES WITH PLANNED STORAGE CAPACITY  
Upper Little Black Watershed, Missouri

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ITEM	UNIT	Structure Number			
		D-2	D-3	D-4	D-5
Class of Structure	-	"b"	"a"	"a"	"a"
Drainage Area (Total)	Sq.Mi.	11.29	1.23	3.14	2.74
Controlled	Sq.Mi.	-	-	-	-
Curve No. (1-day) (AMC II)	-	69	69	69	69
Elevation Top of Dam	Feet	468.7	401.4	384.7	375.4
Elevation Crest Emergency Spillway	Feet	456.2	398.4	380.8	371.8
Elevation Crest High Stage Inlet	Feet	424.3	388.6	367.4	361.2
Elevation Crest Low Stage Inlet	Feet	407.7	-	-	-
Maximum Height of Dam	Feet	82.3	27.9	38.7	35.2
Volume of Fill	Cu.Yds.	555,000	28,600	73,600	82,500
Total Capacity <u>a/</u>	Ac.Ft.	5,128	240	608	521
Sediment Submerged	Ac.Ft.	551	79	177	158
Sediment Aerated	Ac.Ft.	56	8	18	16
Beneficial Use Recreation	Ac.Ft.	-	-	-	-
Retarding	Ac.Ft.	4,521	153	413	347
Between High and Low Stage	Ac.Ft.	1,030	-	-	-
Surface Area	-	-	-	-	-
Sediment Pool <u>b/</u>	Acres	47.0	11.3	20.0	22.6
Beneficial Use Pool Recreation	Acres	-	-	-	-
Retarding Pool <u>a/</u>	Acres	160.0	20.7	43.7	46.0
Principal Spillway Design	-	-	-	-	-
Rainfall Volume (areal) (1 day)	Inches	7.53	6.20	6.20	6.20
Rainfall Volume (areal) (10 day)	Inches	14.73	12.00	12.00	12.00
Runoff Volume (10 day)	Inches	7.28	5.12	5.16	5.16
Capacity of Low Stage (Max.)	cfs	60	-	-	-
Capacity of High Stage (Max.)	cfs	682	30	68	65
Frequency Operation - Emerg. Splwy.	% chance	<1	4	4	4
Dimensions of Conduit	Ft.or In.	4.5'x4.5'	18"	24"	24"
Emergency Spillway Design	-	-	-	-	-
Rainfall Volume (ESH) (areal)	Inches	8.12	5.42	5.42	5.42
Runoff Volume (ESH)	Inches	4.45	2.27	2.27	2.27
Storm Duration	Hours	6	6	6	6
Type	-	Veg.	Veg.	Veg.	Veg.
Bottom Width	Feet	100	30	40	40
Velocity of Flow ( $V_e$ )	Ft./Sec.	-	-	-	-
Slope of Exit Channel	Ft./Ft.	0.090	0.030	0.040	0.050
Max. Reservoir Water Surface Elev.	Feet	445.6	397.6	379.2	371.0
Freeboard Design	-	-	-	-	-
Rainfall Volume (FH) (areal) (-hrs)	Inches	14.55	8.20	8.20	8.20
Runoff Volume (FH)	Inches	10.27	4.52	4.52	4.52
Storm Duration	Hours	6	6	6	6
Max. Reservoir Water Surface Elev.	Feet	464.7	401.4	384.7	375.4
Capacity Equivalents	-	-	-	-	-
Sediment Volume	Inches	1.01	1.33	1.16	1.19
Retarding Volume	Inches	7.51	2.33	2.47	2.37
Beneficial Volume	Inches	-	-	-	-

a/ Crest of Emergency Spillway.

b/ Area to be shown in ( ) if reservoir contains beneficial storage or if sediment capacity will not store water.

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TABLE 3 - STRUCTURAL DATA  
STRUCTURES WITH PLANNED STORAGE CAPACITY  
Upper Little Black Watershed, Missouri

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ITEM	UNIT	Structure Number				Total
		D-7	D-8	D-9	D-12	
Class of Structure	-	"a"	"a"	"a"	"a"	-
Drainage Area (Total)	Sq.Mi.	1.57	1.65	1.25	1.67	191.78
Controlled	Sq.Mi.	-	-	-	-	46.09
Curve No. (1-day) (AMC II)	-	69	69	69	69	-
Elevation Top of Dam	Feet	402.2	395.0	358.7	375.9	-
Elevation Crest Emergency Spillway	Feet	399.2	391.9	355.7	372.9	-
Elevation Crest High Stage Inlet	Feet	389.3	381.0	345.8	364.2	-
Elevation Crest Low Stage Inlet	Feet	-	-	-	-	-
Maximum Height of Dam	Feet	28.2	33.5	31.7	28.9	-
Volume of Fill	Cu.Yds.	52,100	55,700	30,600	69,900	4,436,100
Total Capacity <u>a/</u>	Ac.Ft.	324	333	238	346	59,155
Sediment Submerged	Ac.Ft.	96	101	80	102	7,043
Sediment Aerated	Ac.Ft.	10	10	8	10	737
Beneficial Use Recreation	Ac.Ft.	-	-	-	-	2,213
Retarding	Ac.Ft.	218	222	150	234	49,162
Between High and Low Stage	Ac.Ft.	-	-	-	-	13,302
Surface Area	-	-	-	-	-	-
Sediment Pool <u>b/</u>	Acres	15.3	13.3	11.3	18.0	911.6
Beneficial Use Pool Recreation	Acres	-	-	-	-	298.0
Retarding Pool <u>a/</u>	Acres	31.7	31.2	22.3	38.0	3070.7
Principal Spillway Design	-	-	-	-	-	-
Rainfall Volume (areal) (1 day)	Inches	6.20	6.20	6.20	6.20	-
Rainfall Volume (areal) (10 day)	Inches	12.00	12.00	12.00	12.00	-
Runoff Volume (10 day)	Inches	5.12	5.16	5.12	5.12	-
Capacity of Low Stage (Max.)	cfs	-	-	-	-	-
Capacity of High Stage (Max.)	cfs	31	31	32	31	-
Frequency Operation - Emerg. Splwy.	% chance	4	4	4	4	-
Dimensions of Conduit	Ft.or In.	18"	18"	18"	18"	-
Emergency Spillway Design	-	-	-	-	-	-
Rainfall Volume (ESH) (areal)	Inches	5.42	5.42	5.42	5.42	-
Runoff Volume (ESH)	Inches	2.27	2.27	2.27	2.27	-
Storm Duration	Hours	6	6	6	6	-
Type	-	Veg.	Veg.	Veg.	Veg.	-
Bottom Width	Feet	30	30	30	30	-
Velocity of Flow (V <sub>e</sub> )	Ft./Sec.	-	-	-	-	-
Slope of Exit Channel	Ft./Ft.	0.030	0.060	0.220	0.030	-
Max. Reservoir Water Surface Elev.	Feet	398.0	390.4	355.2	371.8	-
Freeboard Design	-	-	-	-	-	-
Rainfall Volume (FH) (areal) (-hrs)	Inches	8.20	8.20	8.20	8.20	-
Runoff Volume (FH)	Inches	4.52	4.52	4.52	4.52	-
Storm Duration	Hours	6	6	6	6	-
Max. Reservoir Water Surface Elev.	Feet	402.2	395.0	358.7	375.9	-
Capacity Equivalents	-	-	-	-	-	-
Sediment Volume	Inches	1.26	1.26	1.32	1.26	-
Retarding Volume	Inches	2.60	2.52	2.25	2.63	-
Beneficial Volume	Inches	-	-	-	-	-

a/ Crest of Emergency Spillway.

b/ Area to be shown in ( ) if reservoir contains beneficial storage or if sediment capacity will not store water.





TABLE 4 - ANNUAL COST  
Upper Little Black Watershed, Missouri  
(Dollars) a/

Evaluation Unit	Amortization of Installation Cost <u>b/</u>	Operation and Maintenance Cost	Total
Structural measures	557,078	82,340 <u>c/</u>	639,418
Project administration	80,247		80,247
GRAND TOTAL	637,325	82,340 <u>c/</u>	719,665

a/ Price base 1973.

b/ 100 years @ 5-5/8 percent interest.

c/ Includes \$51,578 for operation, maintenance, and replacement for the recreational development.

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS  
Upper Little Black Watershed, Missouri

(Dollars) <sup>a/</sup>

Item	Estimated Average Annual Damage Without Project	Estimated Average Annual Damage With Project	Damage Reduction Benefit
Floodwater			
Crop and Pasture	74,105	10,322	63,783
Other Agricultural	18,577	2,605	15,972
Road and Bridge	5,550	762	4,788
Subtotal	98,232	13,689	84,543
Sediment			
Overbank Deposition	31,382	4,743	26,639
Swamping	1,570	57	1,513
Subtotal	32,952	4,800	28,152
Erosion			
Flood Plain Scour	33,040	5,898	27,142
Indirect	16,422	2,439	13,983
TOTAL	180,646	26,826	153,820

<sup>a/</sup> Price base: Current normalized for agricultural damages and benefits; and 1973 price base for all others.

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TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Upper Little Black Watershed, Missouri

(Dollars)

Evaluation Unit	AVERAGE ANNUAL BENEFITS <sup>a/</sup>					c/ Avg. Annual Cost	Benefit Cost Ratio
	Damage Reduction	Intensive Land Use	Redevelop- ment	Recreation	Secondary	Total	
All structural measures	707,309	80,325	49,800	202,500	105,800	1,145,734	639,418 1.8:1.0
Project administration							80,247
GRAND TOTAL	707,309 <sup>b/</sup>	80,325 <sup>d/</sup>	49,800	202,500	105,800	1,145,734	719,665 1.6:1.0

<sup>a/</sup> Price base current normalized for agricultural benefits, 1973 prices for all others.

<sup>b/</sup> In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of \$8,701 annually. Includes \$378,376 annual benefits from damage reduction in the Lower Little Black Watershed accruing to measures in this watershed and \$183,814 annual benefits from damage reduction in the Black Rock, Lockheart-Ferry, Newport, Augusta and Success reaches of the White River Basin accruing to measures in this watershed.

<sup>c/</sup> From Table 4.

<sup>d/</sup> More intensive land use in Lower Little Black Watershed accruing to measures in this watershed.

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## INVESTIGATIONS AND ANALYSES

The purpose of this section is to present information pertinent in supporting conclusions on which this plan is based. Sufficient information is included to explain the technical aspects of the plan. Items of a routine nature, as set forth in Soil Conservation Service Handbooks of Watershed Protection, Hydrology, Hydraulics, Geology, and Economics, are not included. Supporting data developed for this study will be on file at the Soil Conservation Service state office at Columbia, Missouri.

Work plan development was initiated in February 1966. Studies have been coordinated with the Corps of Engineers, Little Rock District, Little Rock, Arkansas, and the Missouri Department of Conservation. Since planning of Little Black Watershed was authorized in 1966, new legislation has been passed which has increased the detail and extent of the evaluation studies. Extra studies and evaluations have gone into preparation of the Little Black Watershed work plans in an effort to comply with the Environmental Protection Act of 1969 and the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

The Soil Conservation Service contracted for an Environmental Assessment of the Little Black Watershed with the Midwest Research Institute of Kansas City, Missouri. The scope of this study was to supplement Soil Conservation Service investigations and evaluations made during watershed planning and to develop an environmental assessment for use in the environmental impact statement. Evaluation factors include: environmental setting - current and future without project; environmental impact; future environmental setting with project; alternative objectives; alternative measures; relationship between local short-term uses of man's environment and maintenance and enhancement of long-term productivity; irreversible and irretrievable commitment of resources; discussion of controversial issues; conclusions; and recommendations.

### Land Use and Treatment

The Conservation Needs Inventory and Soil Conservation Service Field Office Technical Guides provided information on land capabilities and conservation needs for the watershed. Land treatment measures already applied and cost per unit of application for each measure were obtained from records of Soil Conservation Service field offices and the Missouri Department of Conservation and from farm operators. This information was used in preparing Table 1A.

Forest fire protection is provided by the Missouri Department of Conservation - Division of Forestry and Arkansas Forestry Commission in cooperation with the U.S. Forest Service through the Clarke-McNary Cooperative Forest Fire Control Program. Average annual fire loss of 0.4 percent in Missouri exceeds the established fire loss index goal of 0.2 percent. Presuppression activities and detection facilities are adequate, but additional suppression equipment is needed in Missouri to provide necessary protection to private land.

All land treatment measures to be applied during the project installation period were determined on the basis of treatment needs for watershed protection and flood prevention and on the level of participation expected from local landowners and operators. Consideration was given to the personnel available for planning, funds available for federal cost sharing, and the resources of farm operators for providing their share of funds to install land treatment measures.

### Hydrologic and Hydraulic Studies

Lower Little Black Watershed and Upper Little Black Watershed were studied as one hydrologic unit constituting the Little Black Watershed. Six evaluation reaches in Lower Little Black Watershed and seven evaluation reaches in Upper Little Black Watershed were selected to divide the flood plain for proper hydrologic and economic evaluation. These reaches are shown on the project map.

Little Black Watershed was divided into eight subwatershed areas because of different hydrologic and soil conditions. Soil-cover complex numbers were developed for each subarea under present and future conditions. Future conditions will exist when land treatment outlined in the plan is established. Information on the hydrologic condition of the forest land in the watershed and the reasons for the present hydrologic condition were obtained in a series of systematically selected field plots. The data obtained included measurements of litter and humus layers, determination of soil type, and other hydrologic factors. The presence or absence of disturbance factors; such as fire, grazing, cutting, logging, and the abnormal infestation of insects or diseases which might adversely affect hydrologic condition or increase fire hazard were also recorded. This information served as the basis for developing precipitation-runoff curve numbers and land treatment needs for forest land.

Point rainfall quantities were obtained from United States Weather Bureau Technical Papers 40 and 49 for use in structure design and hydrologic evaluation. Basic rainfall amounts used are as follows:

	Frequency	Duration	Inches
Probable maximum precipitation		6-hour	28.60
100-year		24-hour	7.45
50-year		24-hour	6.80
25-year		24-hour	6.20
10-year		24-hour	5.40
5-year		24-hour	4.65
2-year		24-hour	3.70
1-year		24-hour	3.00
.55-year		24-hour	2.20

Eighty-two valley and bridge cross sections were surveyed on the main stem and upland tributaries. An additional 75 cross sections for multiple-purpose channels were surveyed in the delta area. The flood plain in the upland section was outlined on photographs and checked by field inspection and interview. It was also checked in relation to the 100-year peak discharge elevation.



The flood plain in the delta portion directly affected by flows from the Little Black River is that area of land lying between the upland along the western side of the river and the western edge of a series of sand ridges adjacent to ditch No. 3. Stream flows are generally in a south-westerly direction, but some cross flow also occurs overland because of natural surface slope to the Southeast.

Water surface profiles for floodwater damage evaluation in the upland area were processed by computer. Water surface profiles and rating curves for the delta portion and improved channel section were computed manually.

Channel flood routing was obtained by computer and by the manual convex method. Computer routings were used for the upland tributaries and the main stem above reach VI. Printed hydrographs were obtained for the lower end of each section routed. Flood routing was then extended across the delta portion by manual computation.

For present conditions, hydrographs at the lower end of reach V were divided with approximately 4,000 c.f.s. maximum discharge for a 2-year storm and 8,500 c.f.s. for a 25-year storm remaining in the river flood plain. The balance was routed along the alignment of ditch No. 3 until it rejoined Little Black River in reach X where the hydrographs were added. The separate hydrographs were added at each intervening cross section to make a composite hydrograph that was used to determine flood damage. The manually routed frequencies were expanded to the other four storms studied, making it possible to complete the evaluation. The same process was followed for future conditions assuring a minimum of 500 c.f.s. for a 2-year storm and 1,000 c.f.s. for a 25-year storm through the river. These future conditions were used to determine the final designed channel capacity.

Flood routed volumes were checked against those of actual measurements at various stream gages in the surrounding area. As a result of this comparison, volumes were adjusted upward by 10 percent for all frequencies.

Floodwater retarding structure release rates were established in consideration of downstream channel capacities. Two-stage releases are planned in seven of the large structures (three in lower and four in upper). Individual structure release rates are shown in Table 3.

Monthly flood distribution used in this work plan was developed from a weighted average of 11 stream gauges located in southeast Missouri.

Twelve alternative formulations, in addition to present conditions, were flood routed by computer and manual computations. Six storm frequencies were used in the flood routing of each alternate. Four of these alternates, in addition to present conditions, were processed by a computer program to represent formulations in both watersheds for benefit evaluations. Two additional formulations, without improved channel, were computed by manual methods to assist in allocation of the evaluated benefits between the two watersheds.



### Engineering Studies

Field surveys for all floodwater retarding structures are in sufficient detail to determine storage available and to make final land rights maps. All surveys are based on sea level data and are adequate for construction with minor amounts of additional work needed around the fill and borrow areas. Topographic maps were made by Kelsh plotting and plotted at 4-foot contour intervals in the reservoir area and 2-foot contour intervals in the fill and emergency spillway areas.

Special care was given the larger sites in this watershed. The runoff was increased over minimum as specified in Engineering Memorandum SCS-27 on all sites over 10 square miles of drainage area by a factor ranging from 1.1 to 1.3. Duration and velocity of flow of the freeboard storm was also reduced to the level of smaller structure sites by increasing temporary storage and/or using high c.s.m. second-stage inlets. Emergency spillways on the large sites were planned away from the dam where possible and with bulk lengths to meet the requirements of Technical Release 52.

Special measurements were incorporated into the earth embankment design on all dams because of location in the earthquake intensity zone. The top width of all dams was increased by a factor 1.25 times the normal top width. The slopes were flattened to a 3:1 slope and the height of the dam was increased by 0.05 times the fill height for all hazard class "b" and "c" structures (A-2, A-3, A-7, B-1, B-2, B-9, C-7, and D-2).

Additional storage was added to structure B-3 and B-4 to route them in series with structure B-9. This additional storage made these two structures equivalent to a class "b" structure hydrologically.

Design of the floodway and multiple-purpose ditch No. 3 was based on a 2-year storm runoff from the installed Upper Little Black Watershed and the delta area east of the Little Black River in the Lower Little Black Watershed. The Upper Little Black peak discharge was reduced by 30 percent at the diversion structure by using two-stage inlets and storing a 5-year storm runoff in four of the larger structures. These larger structures were designed with an open port and gated port on the low stage inlet. Due to an 850 c.f.s. reduction in peak discharge at the diversion structure by closing the gates, the size of the floodway was reduced by approximately 25 percent. The floodway, multiple-purpose ditch No. 3, and other channels were designed for stability by the criteria in Technical Release 25.

### Geologic Studies

Sediment investigations were made concurrently with those for the Lower Little Black Watershed. Present land use was mapped on a 40 percent sample of the upland area.

Aerial photographs were used for the field study. Data concerning crop rotations, conservation practices, and changed land use for present and future conditions were obtained from the Carter, Ripley, and Butler

## Investigations and Analyses

Counties, Missouri, district conservationists and staffs. Four areas were studied in Upper Little Black Watershed. A weighted average was drawn from the detailed studies of these watersheds and was used for reservoir areas not studied in detail.

The universal soil loss equation was used to determine soil loss by sheet erosion. Estimated sediment from other sources was based on field examinations and studies in similar watersheds. Sediment delivery ratios, adjusted to the respective drainage areas, range from 18 to 70 percent. Trap efficiency, as determined by the capacity-inflow ratio, is 95 percent.

The average volume weight for upland soils is estimated to be 95 pounds per cubic foot. Submerged sediment in the reservoir is estimated to be 55 pounds per cubic foot. Aerated sediment is expected to be 95 pounds per cubic foot.

Reservoir sedimentation design summaries (SCS-309) were completed for each site. Total sediment storage requirements used in planning are presented in Table 3.

Carter, Butler and Ripley Counties, Missouri, are located in the southern flank of the Ozark uplift. Sedimentary bedrock of Ordovician to Upper Cambrian Age bedrock has a southerly dip of 10 to 20 feet per mile. Past crustal movements have produced folds and faults, many of which are unmapped at the present time. No mapped faults are known in the watershed. The watershed is located in Zone 2, on the Seismic Risk Map, developed by the Environmental Science Services Administration and the Geodetic Survey.

The bedrock formations consists chiefly of limestone, cherty dolomites, and sandstone. Surface expressions of bedrock solution are springs, sinks, and caves. Two minor caves, a few sinks and small springs are present in the watershed. No caves or sinks were observed at structure sites.

Preliminary borings at six sites (A-2, A-3, B-9, C-7, D-2, and D-5), backhoe pits at three sites, and seismic data were used to sample bedrock and soil conditions. Bedrock was hydraulically pressure tested at site B-9 and potentials for seepage were evaluated. Observation wells were installed and monitored at site B-9. A detailed study was not made at any site. General site conditions encountered were projected to sites which were not investigated. Boring logs, profiles and investigation reports were prepared for each site investigated.

Dam abutment areas are usually composed of deep residuum over Cambrian and Ordovician Age bedrock. The residuum consists of gravelly clays and weathered bedrock which are moderately dense, permeable, and subject to moderate consolidation. Dam foundations are in recent alluvial fill over residuum or bedrock. The alluvium consists of various combinations



## Investigations and Analyses

of gravel, sand, and clay. Emergency spillway excavations will be made in residuum or occasionally bedrock. Borrow is available from the valley fill alluvium, terrace deposits, and residuum. Sufficient quantities are available for construction purposes.

Extensive core drilling and pressure testing was done at the B-9 site. Conclusions of investigations and analyses show that the site is a feasible site for storing permanent water.

The intent of these investigations was to determine the average conditions present at representative sites. None of the investigations is in sufficient detail to meet design requirements.

Detailed site investigations will be conducted prior to detailed design and construction.

### Economic Studies

The Economics II computer program was used to calculate crop and pasture, other agricultural, and nonagricultural damages at present and with the project installed. Input data for the computer program was based on data obtained from landowners, agricultural agency leaders, and other knowledgeable persons in the area. Information collected included present land use, crop yields, probable shifts in crop distribution, expected land use after project installation, and historical information on flooding and flood damages. Basic data for estimates of projected yields were obtained from interviews, Missouri Soil Conservation Service Field Office Technical Guide, and local Soil Conservation Service personnel. Fences and roads in the flood plain were mapped in the field and measured for damage calculation.

More intensive land use and drainage benefits were calculated for flood plain area in reaches VI, VIII, IX and X and drainage benefits for the remaining wetland part of the delta area. Associated costs were deducted from gross benefits to obtain the net benefits. Benefits were discounted to allow for a 10-year lag in accrual. An adjustment of 80 percent was used for degree of participation by landowners. Operation and maintenance costs of on-farm land treatment, necessary to realize the benefits, were treated as associated costs in determining net benefits.

Damage reduction resulting from land treatment was calculated as a percentage of the total damage reduction. A study of routings in other projects, having land treatment, was used to arrive at the percentage factor.

Economic and hydrologic studies were made concurrently for the Upper and Lower Little Black Watershed work plans. To facilitate analysis and for planning efficiency, the 82 valley sections were combined into 13 evaluation reaches. Reaches were combined when it was determined that cropping patterns, damageable values, and flooding hazard were similar. This resulted in seven evaluation reaches in Upper Little Black and six in Lower Little Black.



Because both projects consist of one hydrologic unit, some benefits in the Lower project accrue to measures installed in the Upper Little Black project. Allocation of benefits in Lower Little Black accruing to the measures in Upper Little Black was based on an incremental analysis. Floodwater retarding structures were treated as the first increment in the analysis.

The White River Basin Study was used as a source of benefits and damages in the downstream section. Damage reduction in the downstream reaches was determined by the use of the holdout hydrograph method. All benefits are distributed between the Corps of Engineers and Soil Conservation Service projects so that each share equitably on a first-added basis. All benefits are adjusted for a 15-year lag in installation. Because the area controlled in the two Little Black work plans is the same as that used in the White River Study, no adjustment was necessary in assigning benefits attributable to the Little Black projects. Downstream benefits were allocated between the Upper and Lower Little Black projects based on the area controlled by floodwater retarding structures in each project. Benefits in reaches VIII, IX, and X were based on a reduced composite acre value to account for the effects of flooding from the Current River.

Estimate of damages to land by flood plain scour and sedimentation was derived from data gathered in the field by the geologist. These data included acres damaged, severity of damage, and period and degree of recovery attributed to the installed project. Damages were evaluated according to procedures set forth in chapter 5 of the Soil Conservation Service Economics Guide.

Indirect damages considered were depreciation of property in the flood areas; loss of time; additional expenses of operators used in repair and cleanup which would normally be used in productive operation; and additional distances driven by mail carriers, school buses, and farmers because of flooded roads. The indirect damages were computed as 10 percent of the direct damage.

Secondary benefits were computed on two conditions using procedures outlined in chapter 11 of the Economics Guide. One condition was the value of local secondary benefits stemming from the project. These values were determined as 10 percent of the direct primary benefits. Indirect benefits were excluded from consideration in computing secondary benefits. The second condition was the value of local secondary benefits induced by the project. These values were determined as 10 percent of the increased costs that primary producers will incur in connection with increased production. These benefits were not needed for project justification but were included in the overall benefit-cost ratio of the project.

Project installation will provide opportunities for employment of local labor presently unemployed or underemployed. Data from similar projects indicate that labor cost is equal to approximately 50 percent of construction costs. Unemployed or underemployed local labor used in project installation is estimated to be 20 percent. This value was amortized and

converted to a redevelopment benefit. The value of local labor employed in project operation and maintenance was treated as a decreasing annuity for 20 years, converted to an annual equivalent for the project life, and used as a redevelopment benefit.

Value of easements was determined by local appraisal, taking into consideration the current market value of real estate. Area inundated by sediment and flood pools was excluded from damage calculations. An estimate was made of the value of production lost in sediment and flood pools and channel areas after installation of the project. The average annual loss in value of production within the pool areas plus secondary costs was compared with the amortized value of easements. The larger amount, the value of the easements, was used in the economic evaluation.

Current normalized prices were used in this plan for all agricultural damage and benefit calculations. All monetary values have been converted to an average annual basis. All costs were amortized at 5-5/8 percent except associated costs which were amortized at 6 percent. Amortization of the project is for a 100-year period.

### Fish, Wildlife and Recreation

In 1967 fish and wildlife investigations were conducted by the Bureau of Sport Fisheries and Wildlife in cooperation with the Missouri Department of Conservation and the Soil Conservation Service.

A formal investigation of the fishery resource contained in Lower Little Black ditch channels was conducted by the Missouri Department of Conservation in the summer of 1969. Observations were made for standing crop of fish, cover, and channel conditions to provide fish habitat.

In the summer of 1973 the Soil Conservation Service made formal observations of the ditch channels obtaining water length, depth, type of flow, and associated streambank vegetation.

In January 1971 Soil Conservation Service technicians made a field trip by canoe on the Little Black River main stem through the project. This survey identified the areas of critical overbank breaks where the river may change its course. Observations of wildlife, streambank vegetation, and stream flow were made. The observations emphasized the scenic and aesthetic properties of the stream.

Numerous meetings, coordination, and correspondence have taken place between the sponsors, Soil Conservation Service, Missouri Department of Conservation, and the Arkansas Fish and Game Commission to deal with fish, wildlife, and recreation aspects of this project.

From their formal investigations and discussion of the project, the areas of fish and wildlife concern were loss of riparian habitat on the ditch channel, fishery of the ditch channel, and need for public access points along the main stem of the Little Black River. Mitigation and preservation



## Investigations and Analyses

measures will be planned to reduce adverse fish and wildlife effects of the channel modification. Opportunities to provide recreational facilities on the main stem of the Little Black River were incorporated into other aspects of the Lower Little Black Project.

The staff of the Missouri Department of Natural Resources, Division of Parks and Recreation developed the proposal for the water-based recreational development. The proposal includes facilities and day-use capacities to fit needs with resources available. Facilities were designed using design standards from 1972 Recreation Planning Guidelines for Missouri Inter-Agency for Outdoor Recreation. Facilities planned will accommodate 1,763 recreation days per day during the summer period. Thirty-six peak days are calculated to occur during this 100-day recreation season for a total of 63,468 recreation days. Annual usage will be 90,000 recreation days.

The Ozark Foothill Regional Planning Commission has published a Recreational Plan for this regional area. This plan shows considerable need for facilities provided by proposed recreational development in this project. Several of the state water-based recreation parks and the National Ozark Scenic Riverways in this region are considering limiting use because of overcrowding.

Because of projected county and regional recreational needs and the occurrence of high usage on state and federal water-based recreational areas, facilities proposed were designed to accommodate part of the demand for this region.

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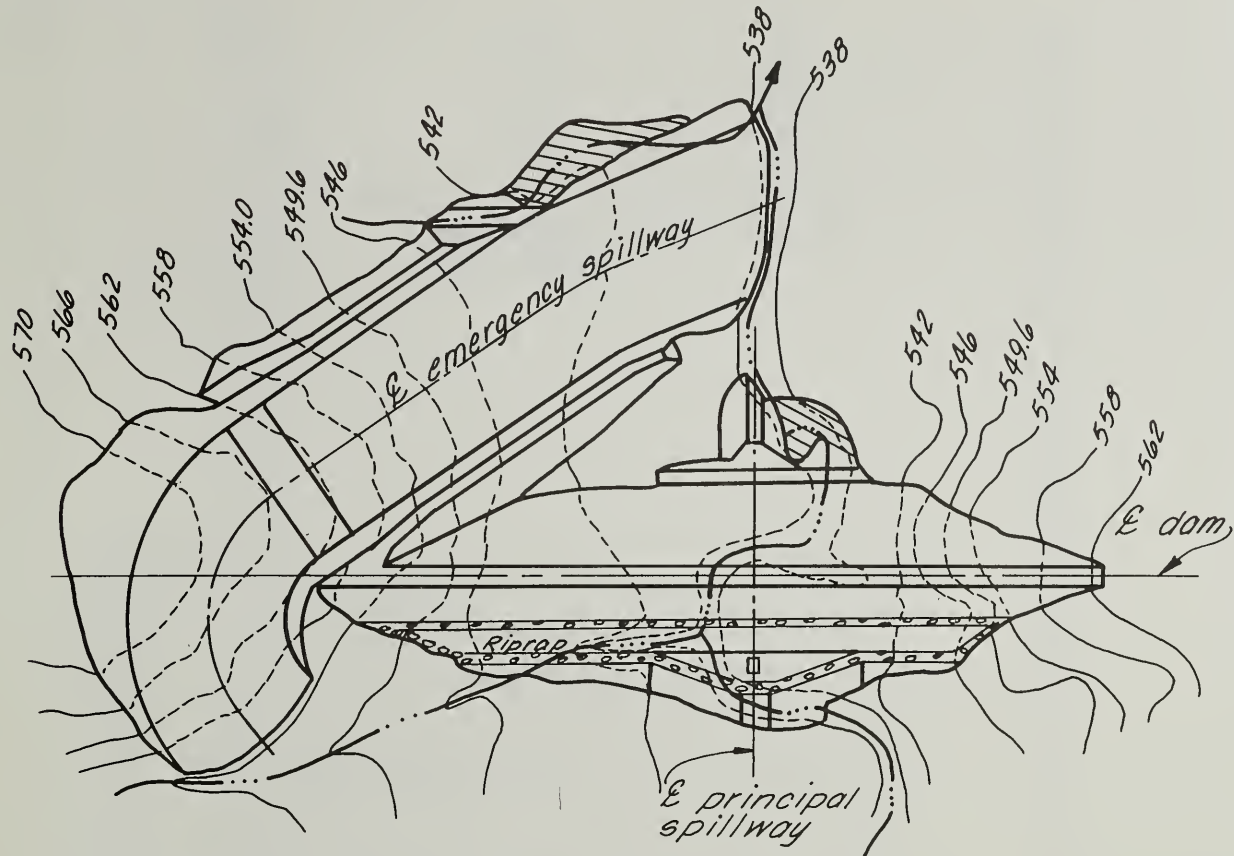
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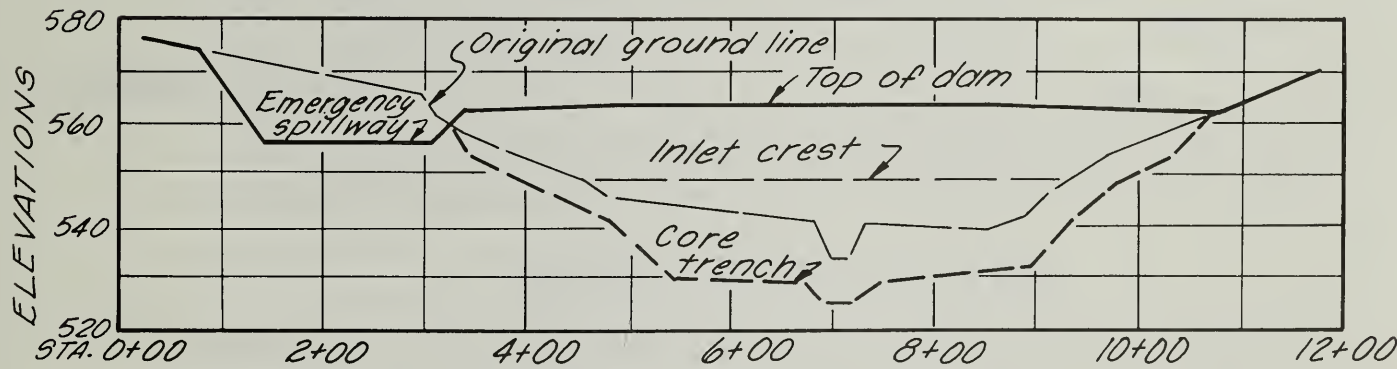
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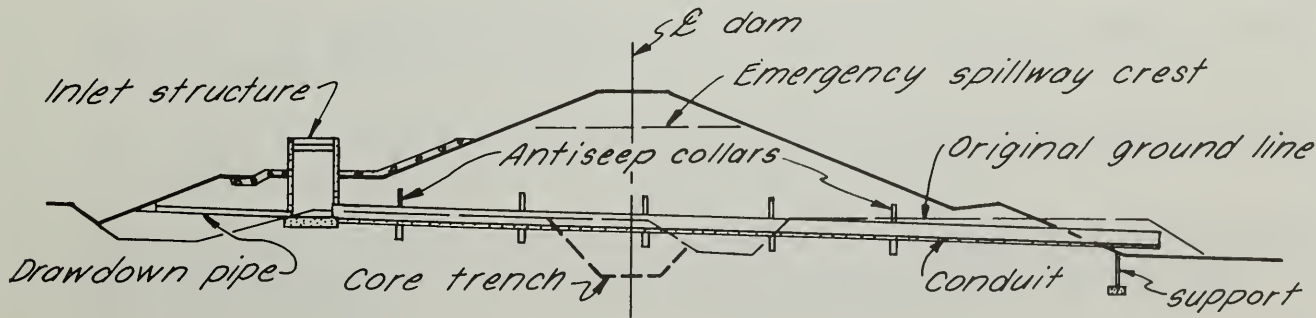
TYPICAL EARTH DAM WITH PIPE DROP INLET



PLAN OF EMBANKMENT AND SPILLWAY



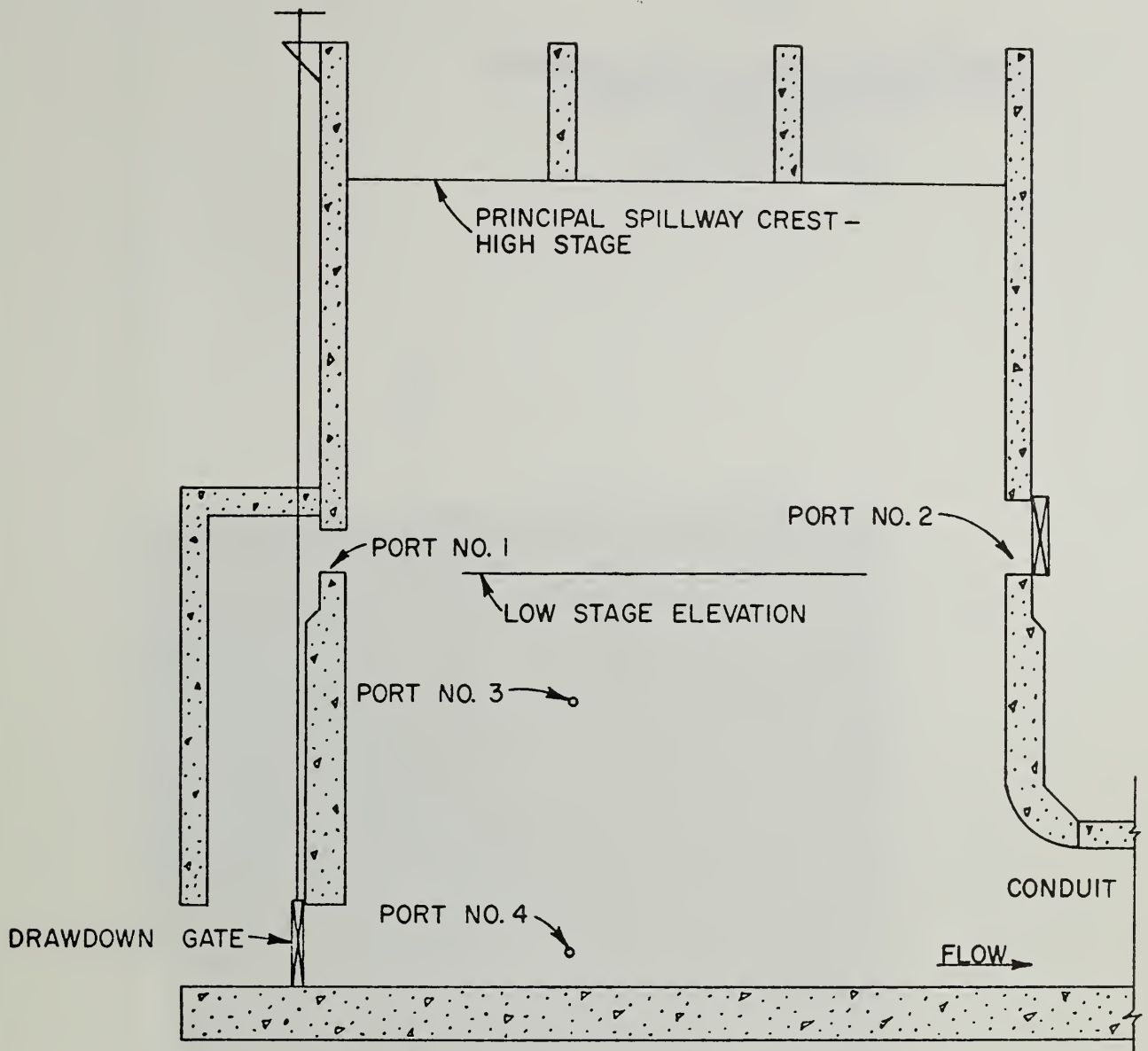
PROFILE ON CENTERLINE OF DAM



CROSS SECTION OF DAM ON CENTERLINE OF PRINCIPAL SPILLWAY







TYPICAL SECTION OF RISER  
SHOWING PORTS REQUIRED IN STRUCTURES A-3, B-9, C-7, & D-2

Port No. 1 is open at all times and is capable of carrying approximately 5 CSM at peak outflow.

Port No. 2 is controlled by a cast iron sluice gate which can be raised or lowered from the top of the dam.

Ports 3 and 4 are water release ports open at all times to release water from the structure to insure more normal summer stream flows during periods of drought.



UPPER LITTLE BLACK WATERSHED  
RIPLEY COUNTY, MISSOURI  
STRUCTURE B-9  
RECREATION SKETCH MAP





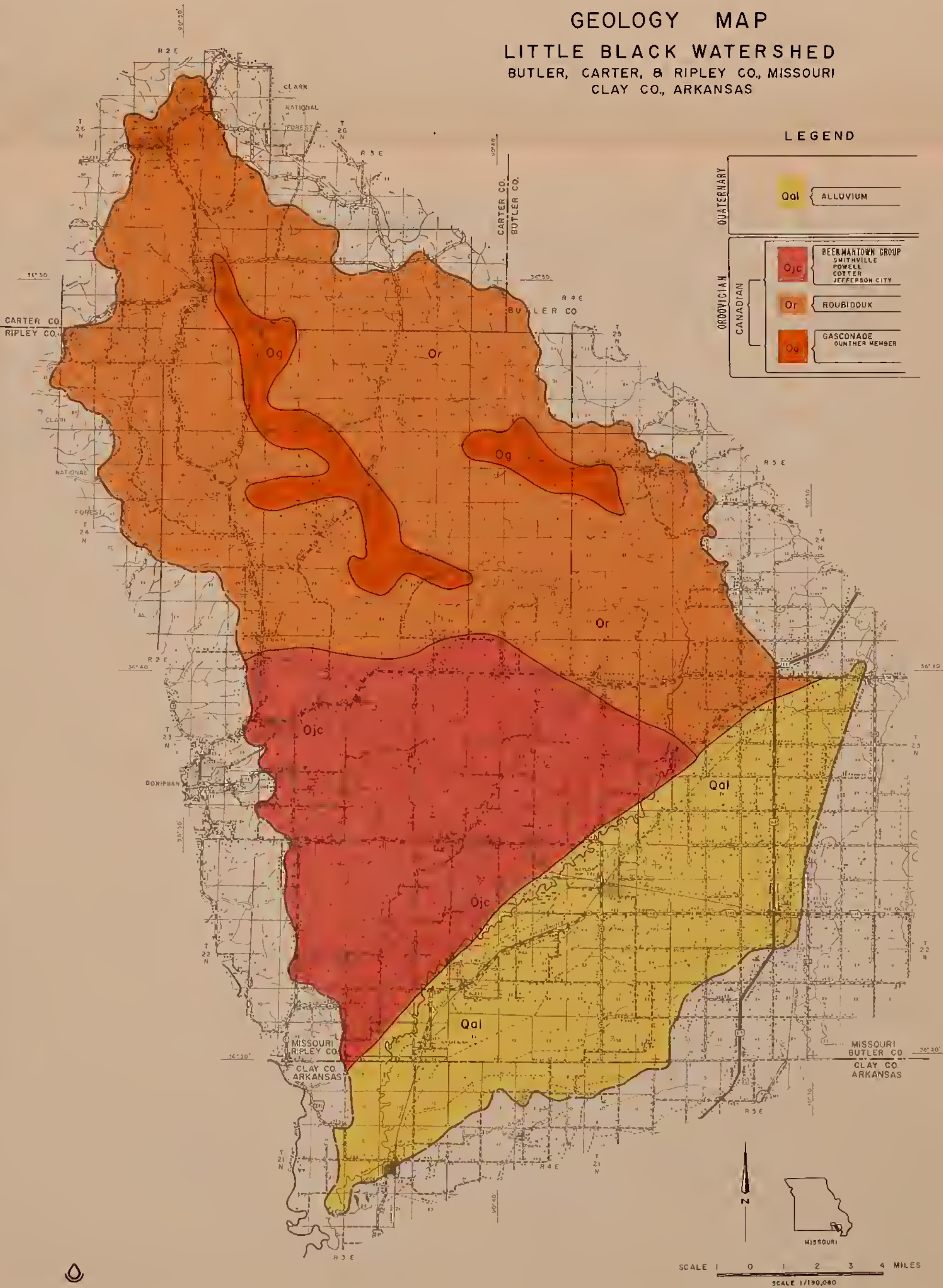


FIGURE 4

GEOLOGY MAP  
LITTLE BLACK WATERSHED  
BUTLER, CARTER, & RIPLEY CO., MISSOURI  
CLAY CO., ARKANSAS

LEGEND

QUATERNARY	Qal	ALLUVIUM
ORDOVICIAN	Ojc	BECKWANTOWN GROUP SMITHVILLE POWELL COTTER JEFFERSON CITY
	Or	ROUBIDOUX
	Og	GASCONADE DUNTHORPE MEMBER







UPPER LITTLE BLACK WATERSHED  
BUTLER, CARTER & RIPLEY COUNTIES, MISSOURI

